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The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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B.C.I.R.A Progress

The annual report and accounts of the British Cast Iron Research Association for the year ending June last were considered at a well-attended meeting and luncheon yesterday. We shall deal with the speeches made at the latter in a subsequent issue. In the meantime there appears to be every cause for congratulation in the results recorded. The year, in fact, shows an increase in income of some 30 per cent., the largest increase in one year yet achieved, and the difficulties of the depressed period seem to have disappeared. The report shows that over 200 representatives of members serve on various committees; that the staff is now about 30; that over 50 reports and translations were issued or made available to members during the period; that something like 8,500 tests of various kinds were made in the laboratories; that library loans reach about six per working day; and that inquiries from members reach about four per working day.

The item to which the Association can point with greatest satisfaction this year is the successful establishment of the British Foundry School. It is difficult to say at this stage what its future will be. If the demand for highly-trained men in the industry is confined to managers and leading executives, and to metallurgists and engineers for the larger establishments, it is unlikely to grow beyond the limits already contemplated of about 30 students per annum. If, however, the industry begins to employ gradually men of a calibre likely to take such a course in comparatively junior posts, the numbers may increase beyond this. Furthermore, something may be done for those men who are so fully occupied in everyday responsibilities that releasing them for a year cannot even be contemplated. Short courses in or near holiday periods may be arranged. The article we published recently, however, is a highly encouraging statement of progress to date, and altogether a novel and outstanding achievement in co-operative effort.

Failures

We have come to regard the Technical Report of the British Engine Boiler & Electrical Insurance Company, Limited,* much in the same light as readers of a famous humorous weekly: "It is not as good as it used to be, but then it never was." We very much appreciate the detailing of the experimental work designed to correlate the bend test with the tensile test, but we have received the impression that this has caused the over-condensation of the technical reports of the more interesting failures encountered by the company during the period. For instance, on page 43, a really interesting study is given of cast iron failures due to abnormality of the metal. The first one dealt with breakages which occurred in piston-pin bearings of oil engines, thirteen years old, a short while after they had been relined with white metal. Overheating during this process was suspected, but examination of the cast-iron shell showed that the metal was abnormal. Its microstructure consisted of coarse lamellar pearlite and balled-up graphite, something similar to white-heart malleable, but free cementite was present, where it had replaced the pearlite. Intergranular cracks were present. Its composition is returned at T.C. 3.20, S 0.53 per cent. and Mn trace. The material must have been cooled slowly as the hardness was normal. The conclusion drawn was that the material was a semi-steel made under unsuitable conditions; as a result, the manganese had been burnt out and the metal had become oxidised; this in turn allowed the formation of the iron sulphide at the grain boundaries. The deposition of the carbon in cementitic form took place at parts highly oxidised and was due to the oxidation of the metal. The intergranular cracks were due to contraction stresses and were extended during the life of the part. The thermal stresses set up when the bearing was relined caused further extension leading to final rupture. We are thoroughly in agreement with this report except in its reference to semi-steel, because in that case the sulphur would be lower and, to our mind, malleable cast-iron scrap was used. Moreover, it would appear that some rough annealing treatment had been given.

A second example also gave us the impression that some malleable scrap had also entered the mixture, but the investigation did not take the matter right back to the mixtures used. Still the lessons of chemical control in the foundry are only too obvious, and perhaps the over-elaboration of their investigations into failures might involve the inclusion of too much matter of a debatable character. This report certainly has a salutary effect on the foundry industry and tends to keep us in a proper perspective.

* Price 7s. 6d., from 24, Fennel Street, Manchester, 4.

Correspondence

Our Thousandth Issue

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—On behalf of the Institute of British Foundrymen, we wish to congratulate THE FOUNDRY TRADE JOURNAL upon attaining its thousandth issue.

The establishment of the Institute of British Foundrymen resulted from correspondence which appeared in the early issues of THE FOUNDRY TRADE JOURNAL. During the thirty-one years which have elapsed since the foundation of the Institute, the closest and most friendly relations have existed between us and the JOURNAL. As our official organ, it has been of inestimable value to us, and we hope that the co-operation which has existed has also contributed in some measure to the success of the JOURNAL, and to the important place which it occupies among the world's metallurgical periodicals.

The developments which are now taking place in the foundry industry are in no small measure due to the enlightened policy which your paper has always maintained, and on behalf of the Institute, which has been so closely associated with you, we wish to tender you our congratulations upon your success, and our sincere wishes for continued prosperity.—Yours, etc.,

J. E. HURST,
President.

TOM MAKEMSON,
Secretary.

The Institute of British Foundrymen,
St. John Street Chambers,
Deansgate, Manchester, 3.

October 25, 1935.

A congratulatory telegram was also received from Mr. J. G. Pearce, the Director of the British Cast Iron Research Association.

Castings and Weldings

Experience of over half-a-century in the metallurgical industries was embodied in the presidential address of Mr. Ralph D. Moore, delivered to the Glasgow University Engineering Society recently. Mr. Moore matriculated at the University 56 years ago, and for many years he has taken a deep interest in the Society, of which he is now President. Some interesting figures were given regarding the use of steel castings in ship construction. In a modern large cruiser the total weight of steel castings amounted to over 700 tons, distributed between hull and machinery as follows:—Hull: Propeller brackets, 160 tons; stern frame, 60 tons; rudder frame, 50 tons; shaft tubes, 70 tons; hawse pipes, bollards, etc., 110 tons. Total, 450 tons. Engines: Thrust blocks, 40 tons; valves and branches, 140 tons; other castings, 70 tons. Total, 250 tons.

In connection with electric welding, Mr. Moore said that contraction stresses had to be taken into account. He strongly advised that all electro-welded fabricated structures, which were designed to replace castings, should, where possible, be annealed. Applied to ship construction, it was to be noted with satisfaction that electric welding was being undertaken with caution, only comparatively small ships having been constructed in that way so far. He had had considerable practical experience of electric welding extending over almost 40 years, and, in the light of that experience, he confessed to a feeling of disquiet over the sole use of welding for putting together the outside plating of a large ship. He recalled the effect of synchronising vibrations on the rivets of certain vessels, and he was afraid in the case of a long line of electric welding the effect of these vibrations might be even more disastrous.

Sir Robert Hadfield on Alloy Steels

Sir Robert Hadfield, representing the Iron and Steel Institute at the Seventh International Congress of Mining, Metallurgy and Applied Geology, held in Paris last week, read a Paper on "Recent Progress in Alloy Steels," in the course of which he said that their value might justly be said to be beyond any monetary value. Modern civilisation could not exist without alloy steels; fortunately, there was every reason to believe that the development of alloy steels would continue to keep pace with modern requirements. Continuing, Sir Robert pointed out that alloy steels represented 8 to 10 per cent. of the total annual world production of approximately 80 million tons. Further, 1 ton of alloy steel supplanted 3 to 5 tons of ordinary steel and fulfilled purposes for which ordinary steel could never be employed. The advance made in heat-resisting and non-corrosive steels was notable, and in the peak year in the United States (1930) the production of these qualities reached 60,000 tons.

Notable examples of the use of corrosion-resisting steels on a fairly large scale were the reinforcements of the masonry in the restoration of St. Paul's Cathedral; also for the Sennar and Aswan dams on the Nile. Over 1,000 tons of such steel were used in revetment work on the Mississippi.

Heat-resisting steels were now regularly employed in boiler and furnace plants. Ferrous alloys were now available which were non-scaling for practical purposes at temperatures up to 1,200 deg. C., and even higher. Sir Robert then referred to his own researches, and said that carefully-prepared estimates showed that manganese steel and silicon steel had effected savings amounting to £1,000,000. Concluding, the speaker referred to the pioneer work which Faraday carried out between 1819-24.

Sir Robert later presented to M. Lebrun, the President of the French Republic, two mementos, the first of which was a copy of the famous picture in the Bodleian Library, Oxford, depicting Roger Bacon presenting a book to the Chancellor of Paris University. Roger Bacon visited Paris in the year 1265 in order to see the renowned University. The second memento was a miniature knife of steel made by Michael Faraday during the years 1819-24, when he lived at the laboratories of the Royal Institution in Albemarle Street, London, where the steel was produced. The steel of which the blade was made contained 0.74 per cent. of platinum; the weight of the blade was one-hundredth of an ounce, and that of the complete knife one-twentieth of an ounce. This tiny knife was associated with Faraday's first research out of the many which followed, and is, therefore, of unusual value. Sir Robert concluded his remarks to the President by saying: "It is not for me to suggest the eventual place where this really 'sacred' knife should rest, but might it not be with my dear friend Dr. Leon Guillet, who is the head of the Ecole Centrale, des Arts et Manufactures, or the Ecole des Mines, in their repository for special specimens or their museum?"

THE LORD PRESIDENT OF THE COUNCIL has appointed Dr. W. H. Mills, Sc.D., F.R.S., the Rt. Hon. Lord Riverdale, K.B.E., Prof. A. Robertson, D.Sc., and Mr. H. B. Shackleton to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Dr. E. J. Butler, C.M.G., C.I.E., D.Sc., M.B., F.R.S., Sir Kenneth Lee, LL.D., and Prof. N. V. Sidgwick, C.B.E., Sc.D., F.R.S., have retired from the Council on the completion of their terms of office.

British Cast Iron Research Association

ANNUAL MEETING

The annual meeting of the British Cast Iron Research Association was held at the Hotel Victoria, London, on Wednesday, October 30.

Annual Meeting

At the opening of the annual general meeting the chair was taken by Mr. H. B. Weeks (Chairman of Council) in the absence of the President—Major F. A. Freeth, O.B.E., D.Sc., F.R.S.—who, however, arrived later.

Presenting the Report and Accounts, the CHAIRMAN said it must be agreed that the Report was a record of continuous progress, and a notable feature was the number of co-operative researches that were being carried out. Commenting on the satisfactory financial position, he pointed out that it had been necessary to ask for special subscriptions in order to earn the Government grant, and whilst thanking the firms who had come to the assistance of the Association in this matter, expressed the hope that the revenue in future years would render any such action unnecessary. The report and accounts were then unanimously adopted.

The election of officers and council then took place, and consisted of the re-election of those at present holding office as follows:—*President*, Major F. A. Freeth, F.R.S.; *Vice-Presidents*, John Cameron, J.P., A. McKinstry, and H. James Yates; *Members of Council*, T. Firth and P. H. Wilson (co-opted during the year and now elected for the coming year). The following were re-elected:—J. B. Allan, Dr. S. F. Barclay, E. R. Briggs, V. C. Faulkner, Prof. D. Hanson, Dr. Harold Hartley, P. Pritchard, J. Smith, and J. M. Weir.

The auditors, Messrs. Poppleton & Appleby, were re-elected.

Consideration was then given to an alteration in the Articles of Association, the object being to remove certain ambiguities. Actually these alterations were passed at the last annual general meeting, but owing to the fact that the overseas members had not received the statutory period of notice, it was necessary to bring them before the Association a second time. The alterations were unanimously agreed to.

Cordial votes of thanks were passed to the members of the Council for their services during the past year, and appreciation was also expressed of the assistance given during the year by the scientific advisers, viz., Prof. Sir Harold Carpenter, Dr. C. H. Desch, Dr. R. H. Greaves, Prof. D. Hanson, Mr. W. J. Rees and Prof. Emer. T. Turner. Mr. A. L. Hetherington (Department of Scientific and Industrial Research) congratulated the Association on the success it has achieved during the past year, both financially and in every other direction.

The PRESIDENT, responding to a vote of thanks to himself for taking the chair at the meeting, paid a high tribute to the work done by Mr. Pearce and his staff, to whom he, in turn, proposed a cordial vote of thanks. He knew a little about the staff of the Association and would make it his business to know a good deal more during the coming year. At the same time he knew sufficient to appreciate the enthusiastic and valuable services of Mr. Pearce and his staff, for which they should be cordially thanked.

MR. H. B. WEEKS seconded the vote of thanks, which was strongly supported by MR. J. CRAWFORD (Messrs. Stewarts and Lloyds, Limited) and carried enthusiastically.

MR. PEARCE, acknowledging the vote of thanks, said that undoubtedly such an expression acted as a great stimulus and encouragement, and the staff highly appreciated it.

Some Experiments with Austenitic Cast Irons*

By P. A. RUSSELL, B.Sc.

This Paper is concerned with austenitic cast iron of the type that is known in Great Britain and America as "Ni-Resist." The austenitic nature of the material is ensured by the presence of at least 12 per cent. of nickel and 5 per cent. of copper. The development of this iron is due to a number of workers in several countries, and it was brought to general notice by the presentation of a Paper by J. S. Vanick and P. D. Merica to the American Society for Steel Treating in 1930.

The composition of Ni-Resist is given in this Paper as:—Total carbon 2.75 to 3.10, silicon 1.25 to 2.00, sulphur 0.04 to 0.12, phosphorus 0.04 to 0.30, manganese 1.00 to 1.50, nickel 12.00 to 15.00, copper 5.00 to 7.00 and chromium 1.50 to 4.00 per cent.

Claims of resistance to corrosion, erosion and heat, and also of non-magnetism, together with certain useful electrical properties, were made for this material, and experience has proved these claims to be adequately justified. Ni-Resist is now a recognised material for the construction of many types of apparatus, and is becoming increasingly important in industry.

It is not proposed to discuss these applications, but to examine the composition given above and discuss, in some measure, the effect of the various elements, both from the point of view of their effect on the physical properties and on the production of sound castings.

Ni-Resist is produced commercially from a mixture of approximately 80 per cent. of ordinary iron and 20 per cent. of Monel metal with chromium additions, and can be melted in a crucible, cupola or any other normal type of melting plant. The difficulties of melting are not great, but the material has a high solidification shrinkage and presents very considerable problems in the production of sound castings where the design is at all complicated.

In the commercial development of Ni-Resist, it has been taken for granted that it is desirable to keep the carbon up as high as possible to reduce these shrinkage problems and to counteract the weakening effect of the high carbon by using low silicon and high chromium.

The standard composition of Ni-Resist usually recommended has been:—Total carbon 3.00, silicon 1.50, manganese 1.00, nickel 12.00 to 15.00, copper 5.00 to 7.00 and chromium 2.00 per cent.

It is not easy to get high carbon owing to the high proportion of carbon-free material used in the composition of the charge, and the fact that the eutectic amount of carbon at this composition is about 3 per cent. The general experience has been that Ni-Resist when crucible melted has given less shrinkage trouble than when cupola melted.

In view of these difficulties the author has carried out some experiments to study the effect of some of the elements upon the properties of Ni-Resist, and he wishes at this point to acknowledge the assistance he has been given by the Mond Nickel Company, who have discussed his results in the light of researches which have been carried out in their laboratories both in this country and by their associates the International Nickel Company, in the United States.

TABLE I.—*Experimental Crucible Melts, showing increasing Chromium and varying Phosphorus.*

Reference no.	T.C.	G.C.	C.C.	Si.	S.	P.	Ni.	Cr.	Tensile strength. Tons per sq. in.	Transverse rupture stress. Tons per sq. in.	Def. in. on 12 in.	Brinell hardness.
8	3.49	2.84	0.65	1.87	0.033	0.11	12.26	Nil	8.20	18.2	Over 0.4	103
9	3.05	2.48	0.57	1.96	0.030	1.76	11.32	Nil	—	16.3	Over 0.4	131
1	3.10	2.51	0.59	2.08	0.028	0.05	13.52	1.91	7.64	19.8	0.16	143
3	2.94	2.40	0.54	2.22	0.026	0.65	13.83	2.10	8.08	20.0	0.15	159
2	3.08	2.56	0.52	2.27	0.026	0.04	13.70	2.60	7.92	19.5	0.14	163

Experimental Data

The author's experimental melts were carried out in a crucible, and results are shown in Table I. It should be explained that all the physical tests were carried out on bars cast 0.875 in. dia., and that the transverse test-bars were broken on 12-in. centres, the results being converted into transverse rupture stress. The tensile strength has been found to follow the transverse strength very closely and so this test has been omitted in some cases. It was also found that the copper content of the material was proportional to the nickel, and so the analysis of this element was not usually carried out. The manganese was also not analysed but was kept fairly constant throughout the experiments at rather over 1 per cent.

Examination of the first two of these results shows the very high deflection in transverse of Ni-Resist when chromium free. The tensile test-bar No. 8 showed an elongation of 4 per cent. The other three results show a distinct decrease in deflection in transverse. All the results show poor tensile and transverse strength, probably due to the high silicon and low sulphur combined with high carbon. It will be noticed that increase in chromium has little effect on the strength but increases the Brinell hardness.

All the experimental melts showed very little trouble with shrinkage, but the strength figures are too low for the irons to be used for normal purposes.

Table II gives the physical properties of Ni-Resist produced on a commercial scale. It will be observed that the strength figures are considerably higher than those in Table I and that the strongest irons are, in general, those with low silicon and high sulphur. The total carbon appears to have little effect on the strength, but increase in carbon increases the deflection in transverse. Observation of the shrinkage of these irons shows that the rotary furnace metal with its higher silicon and lower sulphur gives much less shrinkage than the cupola melted metal.

The higher silicons were originally introduced to counteract the rise in Brinell hardness expected with the lower carbon. Work in this direction has also been carried out by the International Nickel Company in connection with shrinkage troubles which occasionally arose in using standard Ni-Resist. The effect upon shrinkage of altered composition, pouring temperature and mechanical agitation were observed.

The form of test-bar used was a 2-in. dia. bar 12 in. long with a 3-in. dia. head. These bars and heads were sectioned longitudinally for observation. It was found that pouring temperatures varying from 1,400 to 1,200 deg. C. had no effect on shrinkage in any of the experimental melts. Virgin metal of standard composition showed bad shrinkage, but this was reduced by ingotting and remelting. Virgin metal mechanically agitated by transference from one ladle to another showed no improvement.

With regard to composition, bars with the silicon decreased to 1.35 per cent. and the chro-

TABLE II.—*Results on Commercially-Produced Ni-Resist.*

Reference no.	Melting method.	T.C.	G.C.	C.C.	Si.	S.	P.	Ni.	Cr.	Tensile strength. Tons per sq. in.	Transverse rupture stress. Tons per sq. in.	Def. in. on 12 in.	Brinell hardness.
A108	Rotary furnace	2.40	—	—	2.01	0.07*	0.20*	16.66	2.32	13.92	28.3	0.16	—
A42	Rotary furnace	2.54	—	—	2.31	0.07	0.24	14.03	1.77	—	29.8	0.17	—
C3	Cupola	2.64	1.99	0.65	1.50	0.14	0.20*	15.60	2.18	16.18	Flawed	—	192
4	Cupola crucible remelted	2.67	2.13	0.44	1.87	0.13	0.27	12.89	1.91	12.82	30.3	0.19	179
C4	Cupola	2.73	—	—	1.56	0.10	0.21	12.42	2.93	—	33.4	0.15	—
A71	Rotary furnace	2.73	—	—	1.82	0.05	0.31	12.89	2.68	—	29.9	0.20	179
C5	Cupola	2.79	—	—	1.58	0.14*	0.20*	14.95	2.62	—	35.0	0.21	—
B47	Rotary furnace	2.97	2.73	0.24	1.83	0.08	0.19	14.93	2.95	—	28.7	0.22	217

* Analysis estimated.

TABLE III.*—*Experimental Results (International Nickel Company).*

Material.	Tensile strength. Tons per sq. in.	Transverse. Rupture stress. Tons per sq. in.	Transverse. Def. in.	Brinell hardness	Izod impact. Ft.-lbs.	Corrosion rate. 5 Per cent. H_2SO_4 m.d.d.	Corrosion rate. 5 Per cent. HCl. m.d.d.
Standard Ni-resist	12.5	31.5	0.250	—	—	472	456
Low carbon Ni-resist, Bar 1 ..	12.0	31.0	0.170	172	53.5	412	452
,, ,, ,, Bar 2 ..	12.95	31.7	0.166	170	52.5	—	—

* Results kindly supplied by the Mond Nickel Company.

* Presented on behalf of the Institute of British Foundrymen to the French Foundrymen's Association. The author is a director of S. Russell & Sons, Limited, Leicester.

mium increased to 3 per cent. showed bad shrinkage, but sound bars resulted both when the phosphorus was increased to 1 per cent. and when the carbon was decreased to 2.5 per cent. at the same time as silicon was increased to 2.5 per cent.

In view of the success of this last experiment, further investigations were carried out to observe the physical properties of this lower carbon material. The experimental melt from which the bars for these investigations were poured gave the following analysis:—T.C., 2.44 per cent.; Si, 1.79 per cent.; Mn, 1.03 per cent.; Ni, 14.97 per cent., and Cr, 2.0 per cent. (approx.).

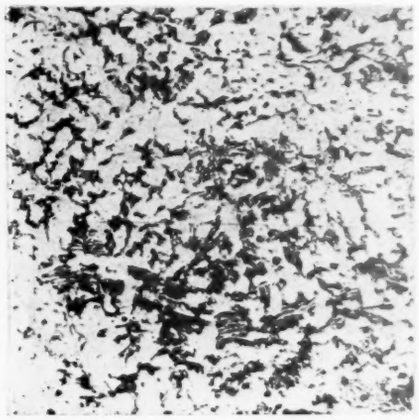

Fig. 1.—Specimen No. 2. × 100.
(Analyses of Specimens are given in Tables I and II.)

Fig. 2.—Specimen No. 2. × 250.

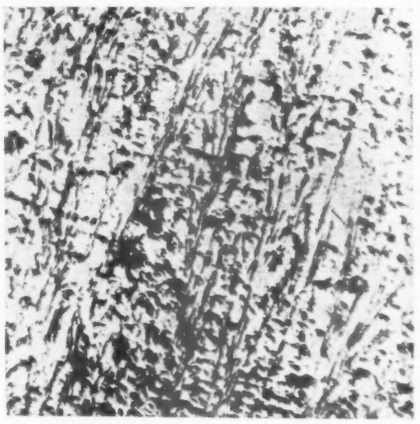

Fig. 3.—Specimen No. B47. × 100.

Table IV.*—*Growth Test Results (International Nickel Company).*

Material.	Percentage increase in volume after cycles of 1 hr. at 815 deg. C. and ½ hr. cooling in electric furnace atmosphere.			
	4	6	11	15
Plain cast iron T.C. 3.18, Si 2.13 ..	1.32	3.10	4.81	6.43
Standard Ni-resist	0.89	0.89	0.89	0.89
Low carbon Ni-resist	1.06	1.06	1.06	1.06

* Results kindly supplied by the Mond Nickel Company.

As the shrinkage test-bar showed soundness it was decided to proceed with the investigations on this bar, in spite of the silicon being lower than that tried in the first series.

The results of these tests are given in Table III, from which it will be observed that the strength is maintained, but that the deflection in transverse decreases. It is also stated that the Izod Impact strength decreases, but no figure is given for standard Ni-Resist. The corrosion figures given were obtained in a 72-hour test in aerated agitated solutions at room temperature, and show that the low carbon Ni-Resist is equal to the standard Ni-Resist.

The growth tests for heat resistance given in Table IV show that, apart from a slightly increased initial expansion, the low-carbon Ni-Resist is equal to the standard grade. In this respect it is stated that it is important that the total carbon should not be less than 2.40 per cent. unless the nickel and copper is over 23 per cent.

Effect of Phosphorus

Reverting to the effect of phosphorus, it will be noticed that in two of the author's experiments (9 and 3, Table I) high phosphorus was used. No benefit from a shrinkage point of view was observed, which is contrary to the International Nickel Company's experiments given above. In view of the danger of phosphorus from the point of view of heat resistance, it was decided not to pursue this aspect of the investigation further, and to attempt to solve the shrinkage problem whilst keeping the phosphorus below 0.3 per cent.

Conclusions

Whilst the author's experiments are hardly complete in themselves, it is possible to deduce from these, and the International Nickel Company's experiments that, providing that ductility is not an important factor, the best composition of Ni-Resist for castings of intricate design is as follows:—Total carbon, 2.5 to 2.8 per cent.; silicon, 1.8 to 2.2 per cent.; sulphur, 0.08 max.; phosphorus, 0.30 max.; manganese, 1.0 to 1.5 per cent.; nickel, 13 to 16 per cent.; copper, 5 to 7 per cent., and chromium, 1.5 to 2.5 per cent.

If, however, ductility is important, then the standard Ni-Resist with carbon about 3.0 per cent. should be used, whilst the maximum ductility and softness is obtained by omitting chromium, the strength of the iron falling off considerably thereby.

It may be found that the low-carbon Ni-Resist specified above gives trouble with hardness in sections of ¼ in. and less. This can be overcome by two methods: (1) increasing the silicon up to 2.5 per cent., and (2) heat-treating the castings by soaking for ½ hr. at 850 deg. C.

Heat-Treatment

If Ni-Resist samples are taken that have been cast in sections of ¼ in. thick or more and subjected to the heat-treatment given above, it is found that the physical properties of the material are practically unchanged both with regard to tensile strength and Brinell hardness, but if the section is less than ¼ in. the Brinell hardness is restored from a high figure to the normal level.

In heat-treating Ni-Resist it is not necessary to cool the material at any specific rate, the essential point being the time at the temperature, which enables the carbides to be partially broken down, producing temper carbon, as shown in the micrograph (Fig. 4).

(*Concluded on page* 327.)

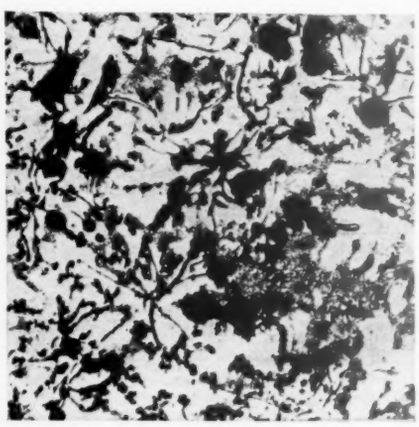

Fig. 4.—Specimen No. 1, after Heat-Treatment. × 100.

Fig. 5.—Specimen No. 8. × 125.

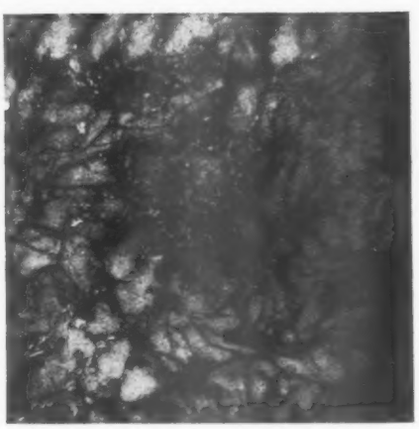

Fig. 6.—Specimen No. 3. Phosphorus, 0.65 per cent., Copper Chloride Etched. × 125.

Notes from the Branches

EAST MIDLANDS AND LONDON BRANCHES

The joint meeting of the East Midlands and London Branches of the Institute of British Foundrymen, held at Derby and Loughborough recently, proved to be most enjoyable and instructive. The London contingent numbered 20 members, including Mr. Vincent Delport, Vice-President, Messrs. Gardom and Beech, Past-Presidents, and Mr. H. W. Lockwood, hon. secretary. Assembling at Derby L.M.S. station at 2.0 p.m., the members of the joint branches, numbering 60 in all, were conveyed to the works of Messrs. Ley's Malleable Castings Company, Limited, Derby, the largest malleable iron foundry in Europe, where the company was divided into parties of 10 and conducted over the works. The arrangements for the visit were in the hands of the works manager, Mr. W. T. Evans (Past-President of the East Midland Branch). At the close of the visit the members were entertained to a buffet tea by the firm. A hearty vote of thanks, which was received with acclamation, was proposed by Mr. Vincent Delport, and seconded by Mr. J. F. Driver, President of the East Midland Branch. Responding, on behalf of the firm, Mr. Francis Ley, general manager, said he was pleased to welcome the visitors. Times were, he said, when such visits were rare and looked upon with a certain amount of suspicion, but it was now realised by most firms that the interchange of ideas and knowledge of other people's methods was essential to the general progress of business.

A Derbyshire Supper

"Ye Olde Derbyshire Supper" at the Irongates, Derby, on the same evening was much enjoyed. After Mr. J. F. Driver had made a short speech of welcome, Mr. Vincent Delport said that while he was very pleased to be able to respond on behalf of the London Branch, he was sorry that he had to do this instead of the Branch-President, Mr. Blackwell, who unfortunately was unable to be present owing to illness. He was sure that he was expressing the opinion of the London members when he said that up to that moment the works visit and the supper had been full of interest and enjoyment, and they looked forward to the remainder of the programme with anticipation. He thought that such events as these would show a most serious and interesting aspect of what the Institute could do.

Mr. H. W. Lockwood, seconding, said it gave him very much pleasure to be able to voice the thanks of the London members to the East Midlands for their hospitality. As a secretary, he knew what a large amount of work was involved in the arrangements of these functions, and he would like to add a personal note of thanks to Mr. Gale, honorary secretary of the East Midlands, for the splendid arrangements that had been made for their enjoyment.

Presentation to Mr. Bunting

Mr. W. T. Evans, Past-President of the East Midlands Branch, said he was called upon to do a duty which gave him considerable pleasure. This was a presentation to the late secretary, Mr. H. Bunting. Mr. Bunting had just retired from the position of honorary branch-secretary after 20 years' service, a record for the Institute, and the work had always been well done. The Branch had made a collection amongst its members, and the esteem with which Mr. Bunting was held could be judged from the fact that there had been no fewer than 82 subscriptions from the Branch. He had very much pleasure in handing to Mr. Bunting an inscribed wallet containing a cheque. Mr. Bunting received the gift, amidst loud applause and the singing of "For He's a Jolly Good Fellow."

Mr. Bunting thanked the members for the very kind words and gift. He had enjoyed doing the work, and had never thought of recompense. He had been a member for 25 years and secretary for 20 years, and he had never had cause for one moment's regret. His membership of the Institute and the friendships made therein had more than repaid him for every minute of time he had given to the Institute and the Branch.

Mr. V. Delport then presented the Diploma of the Institute to Mr. P. A. Russell, B.Sc., for his Paper read before the joint meeting held last year.

On the following day the members assembled at Loughborough College, when two Papers were read. Mr. J. F. Driver presided when Mr. L. J. Tibbenham read his Paper entitled "Is a Mechanised Foundry Worth While?" Mr. Vincent Delport was in the chair when Mr. S. E. Dawson presented his Paper on "Progress in the Foundry."

A vote of thanks to the two lecturers was accorded, on the proposition of Mr. Bunting, seconded by Mr. Beech. Following the session of Papers, the members were entertained to luncheon, and then made a tour of inspection of the workshops and laboratories of Loughborough College. A vote of thanks was accorded to Dr. Schofield, Mr. Driver, and the College authorities, on the proposal of Mr. Bigg, seconded by Mr. Gardom, to which Mr. Driver responded.

Some Experiments with Austenitic Cast Irons

(*Concluded from page* 326.)

The author's experiments have produced some evidence to show that the ductility of low-carbon Ni-Resist can be improved by manipulation of the heat-treatment, but the data available are not sufficient to enable him to put forward any definite recommendations.

Microstructure

The microstructure of some of the samples used in the author's experiments is shown in Figs. 1 to 6. The usual etching reagent for austenitic cast irons is hot hydrochloric acid in alcohol, but the author has found that this method is not always satisfactory, particularly on account of staining. He has, therefore, used the method recommended by the American Bureau of Standards for the detection of carbides in austenitic steels. This is an electrolytic method, the specimen being the anode with a platinum cathode, the electrolyte 10 per cent. oxalic acid and the current six volts. The etching time is 20 secs. All the specimens illustrated have been etched by this method, Fig. 6 having been additionally etched with Stead's reagent for 3 mins. to bring out the phosphide eutectic.

The characteristic feature of these microstructures is the appearance of a well-defined constituent with the introduction of chromium. This constituent is absent in Fig. 5, which is from specimen No. 8 and is chromium free. It is assumed that this constituent is chromium carbide, and that it is this which breaks down to give the temper carbon shown in Fig. 4. This constituent usually appears in one or two distinct arrangements, either as a fan-shaped aggregation, as shown in Fig. 2, or in long streaks, as shown in Fig. 3.

It is noteworthy that the tensile strength of the irons illustrated in Figs. 1 and 5 is practically the same, from which it may be deduced that the graphite size and arrangement is not of great importance. The phosphide eutectic appears to be associated with the chromium carbide, and observation of a specimen before and after etching with Stead's reagent shows that the usual fan structure is broken up by the phosphide eutectic.

Catalogues Received

Foundry Equipment. It is peculiarly interesting that a new catalogue, issued by the Constructional Engineering Company, Limited, of Titan Works, Charles Henry Street, Birmingham, 12, should contain on page 3 a table correlating cupola rate with melting-zone diameter. It is obvious that some action is needed, as even this experienced house makes a footnote recommending the installation of a cupola of a size larger than the output actually required. However, this is beside the point of the real duty of reviewing the actual catalogue, which has been carried out as a loose-leaf binder. The first issue runs to eighteen pages. The items entering the category of melting plant covered include the Titan cupola, with special stress being laid upon the tuyere (this is, we think, misspelt "tuyer" throughout the catalogue) control arrangement; the Titan cupolette, the balanced-blast cupola and mechanical-charging systems, of which four types are described. This section is completed by an illustrated description of two types of spark arresters.

The Sand Wizard, virtually a newcomer to foundry equipment, at present only occupies a page and is shown as two types—one resembling in construction a rumbler, and the other a rotary table. This machine claims castings by the centrifugal action of chilled-iron shot impinging on the parts to be cleaned, in the manner of shot blast, but without the use of compressed air.

The last few pages cover a sand mill, a rotary sand dryer, core stoves, welded tumbling, barrels, pressed-steel and other types of ladles, and, finally, Titanite, the well-known stove pattern-plate mixture. The catalogue, which is produced in an artistic light blue, is available to our readers on request.

High-Duty Cast Iron. The Meehanite Research Institute has published through the International Meehanite Metal Company, Limited, 14 to 16, Church Street, London, N.1, Bulletin No. 5. A definition is given of cast iron with which we totally disagree. It states that "Cast iron is a mechanical mixture of iron and compounds of iron with graphite." This specifically excludes white-iron and cannot be labelled "grey," because the definition would also include "malleable." The definition is followed by the qualification "and the physical properties of any casting depend upon the nice adjustment and relation of these compounds, one with another." "Constituents" would have been a better word than "compounds." In a table which follows this word is used, and ferrite, pearlite, cementite, sorbide, phosphide and graphite are listed together, with their physical condition in a casting, specific gravity, tensile strength (unfortunately, in lbs. per sq. in.), elongation and Brinell hardness. Pages 2, 3 and 4 are devoted to the reproduction of photomicrographs of cast iron, "semi-steel" and Meehanite. We strongly criticise the inclusion of "semi-steel," as its name is virtually obsolete in British metallurgical and commercial circles, as its significance is meaningless. The micros are excellent, and on page 5 the growth of the graphite lamellæ, with increasing section, has never been better illustrated. Finally, by means of photomicrographs at 50 dias. it is well shown that only the 4.1 mm. dia. Brinell ball test is satisfactory for the determination of the hardness of cast irons containing graphite.

Hawthorn, Leslie & Company, Limited, of Hebburn-on-Tyne, hope to employ 2,000 men for two years constructing a cruiser of the Southampton class for the Royal Navy. Other naval work on the Tyne is:—Two 9,000-ton cruisers—H.M.S. "Newcastle" and H.M.S. "Sheffield"—two destroyers at Vickers-Armstrongs' Walker Naval Yard; and two destroyers by Swan, Hunter & Wigham Richardson, Limited, at Wallsend, where H.M.A.S. "Sydney" was recently completed.

Is a Mechanised Foundry Worth While?*

By L. J. TIBBENHAM

Such a title is well worthy of a debate, rather than a Paper, read by an individual, and therefore it is intended to deal with this question in the form of points for and against, rather than in a strictly technical sense.

Many excellent Papers dealing with foundry mechanisation have been read in the past, *e.g.*, by Mr. A. S. Beech in 1930 on "The Future of Foundries in Great Britain, with Special Reference to Continuous Casting," and also the very comprehensive Paper by Mr. F. J. Cook, M.I.Mech.E., in 1933, entitled "Mechanised Foundries." It would, therefore, be imprudent to consider any specific forms of mechanisation even in a general sense. Thus, much more useful deductions could result by enumerating the *pros* and *cons* of foundry mechanisation from an executive's point of view.

Advantages of Mechanisation

Therefore, it is proposed to expound the advantages of foundry mechanisation, not from the point of view of the designer, but from actual practical experience of foundry work where mechanised units have been installed. In this sense it has been the author's privilege over a number of years to study carefully actual costs of production from mechanised units in comparison to an equivalent production without the aid of mechanisation.

As the economic consideration is the basic formulæ of all executives, it is imperative that careful investigation of all prime costs should be made before any capital expenditure is decided upon. In this sense percentage depreciation allocation on overhead expenditure is of paramount importance, and this is the first advantage to be realised by mechanisation. It may be said for foundries in general that a larger amount of material has constantly to be handled to produce a given tonnage of finished goods than is the case with most other processes. In fact, it has been calculated, for example, that 75 tons of material has to be lifted to produce 2½ tons of castings. Surely, then, some form of mechanisation is desirable. All foundry executives appreciate that to reduce the "space factor" or "tons of goods castings per square foot of floor space per annum" for constant labour costs is an economy, but when it is possible also to reduce the direct labour cost as well as the "space factor" by mechanisation, the advantage is obvious.

Continuity of process produces rhythm, which in turn means harmony of production—the aim of all production executives. Time-study data is therefore readily available and stabilisation of piece-work prices more easily possible. The initial result from "harmony of production" is obviously a steady increase in quantity. The component elements of "rhythm" are less fatigue, more intensive occupation and a natural order of sequence. Less fatigue for the operator results from mechanisation both during and after preparation of the mould respectively by overhead sand delivery and conveyance of the finished mould, to the pouring station. It will at once be realised that an increase in production must result from "less fatigue."

Secondly, as the operators on a mechanised unit must work as a team, it is thereby possible to introduce a collective bonus system. Consequent upon such a possibility is a natural tendency towards "more intensive occupation"—with the obvious result in increased production.

If asked to itemise any particular advantages realised in actual practice by mechanisation, the author would like to quote Mr. Beech, as follows:—(1) Continual use of the same floor space over and over again during the day; and Mr. Cooke, in 1933, as follows:—(2) Facility of arranging double shifts owing to floor space having been cleared of poured moulds; and (3) standardisation of box parts as variations in sand content do not have a material effect upon moulding costs.

Finally, a natural order of sequence produced by the rhythm of a mechanised unit is the eulogy of the fundamental principles of mechanisation. The entire unit has the appearance of a system conducive to good planning, which can never result except by mechanical means.

The more shrewd amongst founders may question from the foregoing remarks whether an increased production is the only improvement from mechanisation. But what about the quality? Is it possible that this factor might also be improved? After careful examination of many types of castings produced alternatively with and without mechanisation, it has been found that it is possible also to produce better quality by the aid of a mechanical plant. To the uninitiated this may seem less apparent than the more obvious improvement, viz., increase of quantity.

After more careful consideration, however, it will be realised that, in the first place, a constant quantity of sand is always available for each moulder and, combined with a mechanical squeeze, must therefore tend to eliminate one very important factor which would otherwise be variable. Moreover, by a mechanical conveyance of the finished mould to the pouring station, inaccuracies of handling are avoided. *There is to-day very little fear of disturbance of the mould by a mechanical conveyor, whether the system be of the platform type or merely gravity rollers.*

It still remains, however, to elucidate what is perhaps the greatest economy resulting from the use of a mechanical unit, namely, that less skilled operators may be employed than would otherwise be the case without mechanical means. The intricacies of sand preparation by hand are at once avoided; it is also unnecessary that a moulder should be skilled in the delicate art of pouring, and finally the laborious process of "knocking out" by the moulder is at once dispensed with.

From personal observations, to the advantages previously quoted from the Papers of both Mr. Beech and Mr. Cook, there should be added:—(1) Greatly increased output per man; (2) less sand per ton of castings produced; (3) more consistent quality of castings produced; and (4) fewer moulding boxes required.

Disadvantages of Mechanisation

Having dealt with the advantages of mechanisation, it is now desirable to consider from an entirely unbiassed point of view any disadvantages which may be shown either from actual production costs or by more practical investigations of the finished product. After a careful study of all the advantages to be gained by mechanisation, either by a pursuance of the many excellent Papers written on the subject or by consultations with expert manufacturers of mechanised plants, the prospective client is left with a very difficult problem upon which to decide.

Such might even be the complex task at present before some founder, but it can be stated that it is possible by a process of logical deduction to arrive at a satisfactory conclusion. The first factor to be considered and the question of paramount importance to be decided upon is as follows:—"Is mechanisation suitable for the type of castings which I produce?" Therein lies what may be termed a disadvantage of mechanisation, for the scope of production is limited to certain types of castings. Also it is possible that some castings which may readily be machine-moulded do not lend themselves advantageously to production by a continuous mechanical plant.

Dealing first with the limitation of the scope of castings which it is possible to produce by a mechanical plant, in a general sense it must be realised, of course, that for economical production only comparatively large batches of castings should be consigned for mechanical production. It is no use expecting to produce economically unless "change-overs" are definitely minimised. Apart from loss of time during change-over, there is the question of inaccuracies of "setting," resulting by subjecting a pattern plate to frequency of mounting. Thus there must of necessity be a sufficient number of moulds to take the metal from a continuously-worked cupola of practical size.

Secondly, the choice of castings is limited by the number of cores to be inserted, for, obviously, castings requiring a multitude of cores, or even a small number of complicated cores, naturally slow down production. There are, however, continuous plants producing moulds each containing several cores, but in such instances it was necessary to have extra core setters in operation. Such additional overhead expenditure is not always economical for the smaller types of continuous-moulding plants. In fact, any castings containing cores at all require the services of a core setter independent of the operators producing moulds by a mechanised plant. This is an "overhead" to be accounted for before deciding upon the purchase of a mechanical plant.

Finally, before leaving the question of limitation of scope, it must be realised that serious labour difficulties might result from an introduction of mechanical means. All foundry executives know full well that there are in their employ skilled moulders who have been in the habit of producing certain types of castings regularly, efficiently, and to all intents and purposes as economically as possible.

Even the introduction of machine moulding might result in "passive resistance"—with a consequential drop in production, and therefore the question of "personnel" must be given most serious consideration. Any foundry with these difficulties is less likely to achieve even the obvious success acclaimed for mechanisation than would be the case where machine methods had been universally adopted.

Therefore, the "type of casting" relegates itself into the "type of operator" employed, and it is difficult to advise upon mechanisation unless it were possible so to co-ordinate the entire production with a minimum of disturbance of types of castings already in production, *e.g.*, where a new line of work has been taken on.

Such a procedure may often be inadvisable and might even necessitate the erection of an entirely separate department, the taking on of new unskilled labour, and the entry into a fresh market. These are serious considerations for any executive, and much more important for a board to decide upon. The very structure of an organisation may be threatened, and all the energies of careful planning and building towards the existing success undermined. These items summarise the disadvantages of foundry mechanisation.

No mechanical installation will produce savings unless the general organisation is capable of dealing with the whole situation; that is to say, the management must be sufficiently competent to show the operators how to increase their output, by the elimination of every useless movement, at the same time working with an untiring rhythm.

* A Paper read before a Joint Meeting of the London and East Midlands Branches of the Institute of British Foundrymen, Mr. J. F. Driver presiding.

The Position Summarised

It is not possible for any expert, whether independent, or of a concern manufacturing mechanised units completely to appreciate the entire complexities of any particular business. Therefore, from the aforegoing evidence it will be realised that the wise executive, before presenting his "case" to his board, will reflect upon the possibilities of expansion which may result from the adoption of a mechanised unit. If new lines must be embarked upon, then the market must be "tapped" for possible sources of outlet.

Capital expenditure, whilst an important factor, is by no means the first consideration to be dealt with, for, unless a concern has the possibilities for expansion, even the minimum of expenditure on mechanisation would be uneconomical. This is the first deduction to be made, and, therefore, the deciding issue is simple for any concern once this fact is realised.

Quoting from an actual example, a small foundry was concerned with a production of snap flask moulds, size 16 in. by 10 in. by 3½ in. deep (each half), working on straightforward jobs without cores. By the use of hand-press machines, it was possible to obtain a production of 15 moulds per hr. by placing the moulds on the floor. Afterwards the same machines and operators were made to form part of a small continuous plant, consisting merely of an overhead and hopper and gravity-type conveyor for removal of the finished moulds. When the actual costs were received, it was found that the direct labour had actually been reduced by 50 per cent., because the production had increased to 30 moulds per hr.

A much greater production up to 60 moulds per hr. was eventually obtained by the introduction of super-speed production machines, still using the same conveyor system. Regarding indirect labour, there is an actual example where a foundry using 25 tons of backing sand per hr. required 10 labourers to recondition the sand and clear away the castings. After a modern mechanised plant had been installed, only four men were required. Hence, it may be seen from these examples that enormous possibilities for expansion might ultimately result from the adoption of a comparatively simple mechanical plant.

Having presumably decided that there is a possibility for expansion, the next question to be decided upon is, "How far shall mechanisation proceed?" Consequent upon such consideration is the fact that a mechanical unit might be used to advantage only when there is a sufficient demand for a reasonably wide range of castings. Having emphasised upon the fact of "limitation of scope," such a remark may seem contradictory, but it should be realised that it is only when the demand is sufficiently great both in types and quantities that a mechanical unit may be worked to economic advantage.

Next in order of sequence for consideration is the question of capital expenditure. As mechanised units are of comparatively new origin, a sufficiently high depreciation should be allowed to counteract the possibility of a plant becoming "obsolete" by the introduction of more efficient units consequent upon present-day research. This is a very important point, and one which might even be a deterrent to a prospective purchaser, but unless an executive can foresee sufficient return to warrant maximum depreciation, then *any* kind of installation would be an uneconomical proposition.

Finally, the space factor must be realised; the reduction of the "space factor" is the aim of all foundry executives, either directly or indirectly. This is the greatest advantage consequent upon the introduction of a mechanised unit, and once this question has been settled to advantage, the issue should be perfectly clear.

It is recommended, therefore, that all foundry executives contemplating the installation of a continuous-moulding plant should give most serious consideration, in this process of logical deduction, to the question of "space factor." The definition of "space factor" is "weight of castings per square foot of floor space per unit of time."

Suppose that an imaginary foundry has no mechanisation of any description, not even the simplest of moulding machines, the space factor for such a case can be easily ascertained from the following formula:—

$$\text{Space factor} = \frac{\text{Total weight of good castings produced per annum}}{\text{Total available moulding space (sq. ft.).}}$$

Let it be assumed that the result is one (unity).

Now consider the installation of simple moulding machines as the only means of mechanisation to be adopted. From actual practical experience the space factor would then be approximately two.

Finally, contemplating the installation of an up-to-date continuous plant comprising a battery of high-speed moulding machines, overhead sand hoppers, sand re-conditioning plant, and a finished-mould conveyor. As a modest estimate the space factor should now be six. In other words, we should have the possibility by complete mechanisation of producing six times our original output with the same floor space, or, alternatively, that one would require approximately one-sixth the floor space to produce the original output.

Cost

In order to determine whether or not the installation is an economical proposition, alternative costs should be obtained as follows:—(1) The cost of new buildings with the necessary heating, lighting, etc., together with the necessary machines to increase the output until the space factor becomes approximately six; and (2) the cost of a completely mechanised plant utilising the existing space factor but actually to produce the equivalent of (1).

The answer to these two alternatives is simple, for if the cost of scheme (1) is equal to or greater than scheme (2) then, as previously stated, the issue is perfectly clear.

In addition to these considerations one must not overlook the power required to operate a mechanised plant together with the general maintenance costs, as otherwise this might become a figure of real importance.

Before concluding this Paper it seems desirable to enumerate the components of a modern mechanised unit as follows:—(1) Moulding machines; (2) sand-handling plant; (3) sand conveyor; (4) mould conveyor; (5) knock-out arrangement; (6) core storage; (7) arrangement of operators; (8) pouring arrangement, and (9) removal of spilt sand. The author extends his thanks for the assistance received in the preparation of this Paper to his general manager, Mr. Marland, Mr. A. S. Beech, Mr. A. W. G. Bagshawe and to Messrs. Herbert Morris, Limited, for the loan of a film.

DISCUSSION

Mr. T. Goodwin asked what type of plant would the lecturer put in to deal with the 20 tons of malleable iron which he saw tapped and poured yesterday in less than half an hour.

Mr. Spriggs assumed that Mr. Tibbenham was quite definitely in favour of mechanisation. He (Mr. Spriggs) said he had known definite cases of a space factor of five times. He knew of one case where 3,000 moulds were made in one shift in a mechanised plant, and that could not be possibly done by hand moulding. Another important point was the time factor, which often seemed to be neglected. To give an illustration in simple arithmetic—if a job paid at 2 hrs. at 1s. per hr., 2s.; plus oncost 100 per cent., 4s. If that job were mechanised and the time reduced to 1 hr., it would be possible to pay at a higher rate per hr. and with the 100 per cent. oncost there would be a considerable saving. Facts bore out that the oncosts of a mechanised plant were not increased. There was a considerable saving on sand preparation and a saving on the knock-out. An efficient knock-out would yield a saving of 50 per cent. alone in labour cost. He agreed that depreciation should be at a high figure, but he did not think Mr. Tibbenham was correct in saying this should be high because the plant would soon be out of date, but because of the service that would be put on the plant. He estimated depreciation of conveyor plants for a 10 years' life. Another stumbling block raised against mechanisation is the high maintenance charges. He thought that the engineer had now "got down to the job" and understood the conditions in the foundry. One had to be careful not to damage the moulds on a conveyor of the roller type. The gravity conveyor was a "half-way house" to mechanisation. It would give extra production, but one did not get the full saving as with the continuous conveyors. The gravity conveyor had its use; it enabled one to "batch" work. He agreed that coring-up was a difficulty that the foundryman would certainly have to overcome. The motor-car manufacturers made cylinder blocks on conveyors, and they were a heavily-cored job. Mr. Tibbenham maintained that the quality should appreciate, and it was found one of the first things asked about mechanisation was whether the castings would be improved. Mechanised plants would give better castings, but the mechanisation expert could not give full information. For sands the foundryman must use his own experience, and the foundryman must be enthusiastic if he desired full service from his plant.

Scope of Mechanisation

Mr. Beech said one must not assume that there was no possibility of mechanising because one had no running line of castings to produce. There might be more difficulties, but it was possible partly to mechanise, even for jobbing quantities. Moulding machines could have sand hoppers. The operator could be employed on the skilled operations instead of shovelling sand.

Some of the advantages he would give were as follow:—(1) The foundry is kept more clean, and where there is cleanliness there is more efficiency; (2) correct conditioning of sand; (3) leaving moulders free to produce and not to do labouring; (4) where continuous melting was in use there was a real reduction in number of moulding boxes; (5) more care of patterns and plates, and (6) regularity of weight; this is a point that is not sufficiently controlled.

Two Hours' Work!

Mr. C. W. Bigg said he could not agree with Mr. Spriggs that the author was definitely for mechanisation. He (Mr. Bigg) came to the conclusion that his positives and negatives balanced. This Paper dealt with a very important subject, which founders could not afford to ignore. Did not the question become one of the efficiency of the plant? But that was not the point for the foundryman. The point to be considered was the efficient working of the plant into his individual conditions. He had seen plants that could make a large production, but had decided that he could not recommend such a plant to his board. One had to consider not only floor space. The speaker had mentioned ratio of floor space in his own foundry to that of a competitor, where the competitor had 3½ times the space, but only 2½ times the production, and he had put this down to the fact that he was mechanised. Floor space might be cheaper than mechanisation. Mr. Spriggs had made a point of "overheads." One must remember, if one reduces productive labour, that overheads must go up as a percentage. Mr. Tibbenham had mentioned visiting a plant, and said it was not used to the extent it should be. Good plant, badly used, becomes bad plant. The responsibility on the introduction and utilisation of the mechanised plant was

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the foundryman's. With the introduction of mechanisation one only removed the skill. The industry needed more skill, better technique, and better management. The opinion may have been formed that he was against mechanisation; actually he was in favour of it. There were firms fortunate to have lines which lent themselves to mechanisation. He would like to eliminate unnecessary labour in the foundry, as a contribution to general progress. Coring-up was not the only thing to cause difficulty; there was the making of the cores. He was recently in a foundry making 150 moulds per hr. from two machines, producing 700 castings per hr. Translated to his own works, he could produce the moulds, and for that number of moulds he would want 2,500 cores per hr.—cores of dimension and intricacy—and having done that, he would be able to employ the job for 2 hrs. per week to satisfy the customer's demand.

Mr. Bunting said it would be a brave man, or a lunatic, who would object to mechanisation entirely, but, as had been emphasised, it was a question of over-mechanisation. Many were familiar with mechanised plants, and he knew of cases where the costs were higher than in foundries without mechanised plant. That was no fault of the plant, but of the management using the plant.

Mr. Gardom said this had been a very instructive Paper. Anything that could be done by hand could be done better and more quickly by machines; but was it worth it from the money side? Mr. Tibbenham had stressed that the management must be competent. He was glad that had been stressed, as it was only on the management that any burden was put. The only "sweating" was by the management. Mr. Tibbenham had said that experts could not advise. As a person who was put in the position of an "expert," he would complain that the reason of this was that the foundryman would not give the information that was necessary for the expert to give advice. When one was considering mechanisation, there were two main essentials to consider. The first was the metal facilities, and the second was the knock-out. The remainder would fit in.

Mr. S. E. Dawson said that, as far as the discussion had gone, he thought the title might have been different. It would appear that it should be "Is a 'Suitably' Mechanised Foundry Worth While?" and the answer would be "Yes." A few years ago he had wanted to increase output on a given floor space. He had considered the installation of machinery. The job was in 14-in. by 10-in. boxes, which were being produced at 80 per hr., but the plant would occupy half the space, and, when one came to consider the space occupied, there was only space for 40 per hr. That was a case where it was not worth while, and was turned down. In most foundries the floor space seems to be too small. Mr. Gardom had mentioned metal facilities. In many foundries it was a case of whether the melting unit should not be speeded up. Instead of having one unit to supply the whole floor, it could be separated into several smaller units. He had tried that some time ago, and with the smaller units he used the same boxes four times in one day. He melted for about 40 min. each heat, and used the same boxes four times, and the same floor space four times. Efficiency of plant had a considerable bearing on this question. He had replaced a sand-mixer with a later type, and got 2½ times the amount of sand, better prepared, with a smaller unit, and cut down the labour by 2 to 1. In deciding one must consider the area in which the foundry was situated. In some parts one was able to get 120 boxes per hr., and in another area only 40 parts per hr. By introducing similar facilities the production was raised from 40 to 80, but the management could not get up to the 120. Labour varied in districts. In France output was lower than in England. In Italy it was much greater than in France, and almost equal to England. If anything went wrong with a mechanised plant, the whole shop was held up. When having mechanised plant, one must also have the necessary skilled labour to see that it did not break down, and so, by removing skill in one direction, one applied it in another.

Mr. Delport said he would like to emphasise one point from the costing point of view. Before installing one must be satisfied that the plant would be used to capacity. One was charging the balance-sheet with a capital charge, and that charge must be written off and the interest on capital must be considered. If the plant was only used occasionally, that job must bear the cost, and the job would probably cost more than if made on the old system. Another point was that one must be satisfied that the plant would be adequate for the production and type of work required. He had seen a case in America where a plant had been installed costing 180,000 dollars, and after six months it was found to be unsatisfactory and the whole plant scrapped.

Author's Reply

Mr. Tibbenham said that the discussion had not given him many direct questions to answer. Mr. Goodwin had asked a point-blank question. He felt certain that it was possible partly to mechanise the plant mentioned. He could not attempt to advise the type of plant required, but it could be done in some aspects. If one only considered the number of steps the moulders take from machines to floor to place down the moulds, it would be seen that the gravity conveyor alone would increase the output by at least 15 per cent. Mr. Spriggs had emphasised the time factor, and he agreed with him. He had suggested a life of 10 years; that was the usual depreciation allowance on foundry plant, but he would like to suggest that the depreciation would be greater than that. He had also mentioned breakage of moulds on gravity conveyors, but that could be overcome with suitable care. Mr. Bigg had raised the question whether floor space was cheaper than mechanisation; that was also his question, and he favoured mechanisation. Mr. Gardom had taken up the point of expert's advice. He still thought that the foundry management should know more about it than the expert, but they must take the advice of the expert into their deliberations when deciding what type of plant to purchase. He agreed with Mr. Dawson that the word "suitable" would improve the title of the Paper.

Publication Received

Aluminium in Architecture and Decoration. Published by the British Aluminium Company, Limited, Adelaide House, King William Street, London, E.C.4.

We were impressed by the following statement which appeared in the introduction to this wonderfully illustrated brochure:—". . . recently a famous bridge was condemned as being no longer fit to carry the increasing volume of road traffic. By replacing the steel members of the floor with light-alloy members of greater strength, it was possible to give the bridge a further twenty-five year's life, say, £313,000 to the taxpayer." There must be some thirty odd pages of pictures showing how prominent architects have used aluminium as a combined medium of decoration and structure. Mr. John Longden's statue of "The Runner" is also included. That the use of aluminium is not new is shown by an illustration of the lift-shaft inclosure and the purser's office grille of the R.M.S. "Mauretania," which were made by a London foundry twenty-seven years ago. The extremely high standard set for themselves by the publicity department of the British Aluminium Company has been more than maintained.

Book Review

Electric Melting Practice. By A. G. Robiette, B.Sc. Published by Charles Griffin & Company, Limited, 42, Drury Lane, London, W.C.2. Price 15s. net.

The electric melting of steel, practised more or less tentatively prior to 1914, gained a considerable impetus during the war period, but in the slump which followed numbers of furnaces went out of commission. The last few years, however, have seen notable developments in electric-steel melting, both in the tonnage of steel produced in this way and in the design of plant and methods of operation from the point of view of obtaining a better product. Much information regarding these improvements has been published in technical journals and the transactions of various learned societies. Mr. Robiette has collected together this information, summarised it and added to it his own considerable experience; the result is a book, "Electric Melting Practice," which, deservedly, will be widely read and studied by metallurgists and others concerned or otherwise interested in the electrical melting of steel and other metals, and the advantages which may be obtained by this method of melting as compared with others.

Although the author deals with various types of electric furnaces and with their application to the melting of metals other than steel, probably the two most important chapters are those dealing with the arc melting of steel and the use of coreless-induction furnaces. The former gives a carefully reasoned account of various arc furnaces which have been used commercially, methods of working them and the type of product which can be obtained. To the reviewer, the most interesting chapter, however, is that on coreless-induction furnaces, and particularly that part of it dealing with the use of these furnaces for refining operations as distinct from the purely direct melting for which they are generally employed. The author's summary of what has been done in this direction is extremely good. He does not minimise the difficulties which have been, or still remain to be, surmounted—particularly those connected with the production of suitable slags which will be sufficiently fluid and reactive to fufil their purpose and yet not have too great a cutting action on the refractory furnace lining—but he emphasises the advantages which are inherent in a furnace in which the molten metal is constantly circulating, every part thus being brought into contact with the slag. As a result of this movement, reactions between metal and slag take place much more quickly than in other types of furnaces in which the bath is more or less quiescent and their continuance depends largely on the speed with which slag or impurities can diffuse from parts of the bath remote from slag-metal interface. The author shows what has been accomplished in this direction and his account opens up extremely interesting possibilities in the future. We congratulate Mr. Robiette on his book, and strongly recommend metallurgists and others interested in metals to read it carefully. J. H. G. M.

Modulus of Rupture.

In Mr. Harbach's letter, printed in our last issue, two misprints occurred. The first was in connection with Example No. 1, which should read $\frac{1.5 \times 36 \times 6}{4 \times 4}$, and not $\frac{1.5 \times 36 \times 36}{4 \times 4}$ as printed. The second was in connection with Example No. 3, where, by carrying the 1.2^2 to a second line, it suggests this is above the line in the calculation, whereas it is below the line. We sincerely regret these errors.

The British Cast Iron Research Association

ANNUAL REPORT

At the Annual General Meeting of the British Cast Iron Research Association, held in London recently, the Fourteenth Annual Report was presented, of which the following is an abstract.

The year under review, which ended on June 30, 1935, was one of the most active and progressive in the history of the Association. Important extensions have been made to the development and research programme, details of which are given in the body of the report. The services rendered to members have also increased, and during the year plans were completed for the establishment of the British Foundry School, which opened for its first session on October 15.

Increased Income

It was reported last year that the Advisory Council to the Department of Scientific and Industrial Research had offered to increase its grant by £2,000 per annum, subject to the receipt from the industry in Great Britain of £7,000 in grant-earning subscriptions. At the same time slight changes were made in the basis on which subscriptions qualify for grant, and in order to raise the £7,000 it became necessary to increase the total industrial income during the year by nearly £1,000. The Council, after careful consideration, decided that it was undesirable to modify the normal subscription scale now in operation, with the result that a much greater income was required from new members than previous experience indicated could be obtained in one year. The Council, however, has pleasure in reporting that the required figure was obtained with the assistance of a group of larger members of the Association, who altogether subscribed a sum exceeding £300 in order to make up the required figure and to ensure the increased grant. The income for the year is thus a new high record, totalling £13,370. As the same assistance cannot be expected this year, the Council trusts that eligible members will support the Association not only in order to make up the minimum quota of £7,000, but because further grant on the £1 for £1 basis is available for subscriptions exceeding £7,000 to an extent which makes it possible for the Association to reach its ultimate goal of £20,000 per annum.

Committees

The principal committees of the Council, Research, Publications and Education Committees were re-elected. The Research Committee unanimously elected Dr. H. Hartley as chairman. Four meetings have been held, with an average attendance of seventeen. The detailed working of the Committee is dealt with through eight sub-committees and several panels. During the year twenty-five meetings of these groups have been held, with an average attendance of 15. The Publications Committee re-elected Mr. W. B. Parker, F.I.C., as chairman, but during the year he felt compelled to relinquish this office, which he had held since the Association's inception. Mr. T. M. Herbert, M.A., was unanimously elected as his successor. The Education Committee re-elected Mr. E. R. Briggs, M.Inst.C.E., as chairman, and only one meeting has been necessary.

Melting Practice Sub-Committee

Following the installation of the Association's cupola furnace of the balanced-blast type referred to in the last Report, an investigation has been undertaken in co-operation with the L.M.S. Railway Company on the melting quality of metallurgical cokes. About twelve cokes were chosen, representative of the material available from the various areas of the country supplying metallurgical coke of the quality normally used in foundry practice. The cokes were then tested over a full day's run at the L.M.S. foundry at Derby, more than 50 tons of metal being melted at each trial. Full observations were taken. Subsequently arrangements were made for each coke to be tested in the B.C.I.R.A. cupola with charges of known and uniform composition in order to ascertain the carbon pick-up and sulphur pick-up in the resulting metal. The tests at Derby are virtually completed, and half the tests at Birmingham are completed. Concurrently, laboratory tests on the cokes are being made and the Northern Coke Research Committee (Prof. H. L. Riley), which works in close conjunction with the Iron and Steel Industrial Research Council of the British Iron and Steel Federation, kindly undertook to carry out some specialised laboratory tests on the cokes with a view to the correlation of laboratory tests and practical results.

During the year, in view of the great interest being taken in new types of rotary furnaces using pulverised fuel or oil, the Melting Practice Sub-Committee formed a group of rotary furnace users in the Association, called the Rotary Furnace Panel. Two meetings have been held with the object of promoting discussion on the ways in which the advantages of such furnaces may best be realised. In order to provide a basis for further work on furnace linings, both for rotary furnaces and cupolas, questionnaires have been prepared and circulated to all members operating both rotary furnaces and balanced-blast cupolas. The replies are now being examined.

The development of the balanced-blast cupola proceeds very satisfactorily. In the last Report it was recorded that sixty-one cupolas had been installed or were under construction with a total hourly output of 386 tons. At the present time the total number of cupolas installed or under construction is ninety-five, with a total hourly output of 670 tons. They have been installed and operated with entire success not only in this country but in Australia, India, the United States, Denmark and Czecho-Slovakia. Many letters have been received from users testifying to the success and value of the installation. A most satisfactory feature of the development is that many of the furnaces now under construction are further installations in foundries where the system was originally applied to one furnace. The furnace is now to be found in the works of nearly 20 per cent. of the members of the Association and it is estimated that the total annual saving in fuel realised by them is approximately three times the total income received by the Association from the industry.

Sands and Refractories Sub-Committee

Reference was made in the last Report to the contemplated removal to headquarters at Birmingham of the work on sands and refractories previously carried out at Sheffield under the supervision of Mr. W. J. Rees. During the year this transfer was completed and not only is the sands laboratory now working normally at headquarters, but furnace equipment has been installed in order to provide adequate tests for refractoriness. The time of the senior investigator has largely been occupied in advising and visiting members with regard to moulding sands, core sands, refractories, coal dust, etc. The research programme has also been extended and an additional investigator appointed to deal with clay-bonded sands. Most founding is carried on in naturally-occurring moulding sands, and based on its previous investigations, the Association has been able to render members assistance with regard to the choice of raw material and the most appropriate grain size, moisture content, ramming density, and the most suitable methods of mixing and treatment for green-sand, dry-sand and loam working. Casting in natural sands is bound to continue to predominate. At the same time developments in modern founding of continuous production and of large-scale production have necessitated methods for producing synthetic sands by the addition of clays to silica sands or by the replenishing of the clay bond in natural sands after its destruction by the molten metal. The new investigation is principally concerned with the choice of appropriate clays, the most suitable proportions to add, and the best amounts of moisture and methods of treatment to use. Considerable progress has been made. The replies to the questionnaires referred to above on furnace linings are being utilised in the formulation of an investigation on refractories and linings for cupolas and rotary furnaces.

Grey Iron Sub-Committee

Difficulties arising out of the shrinkage of grey and malleable iron furnish the greatest problem with which the founder is faced and the development of modern high-strength irons has intensified these on account of the high shrinkage of low-carbon irons. Difficulties confront any systematic investigation into this matter because shrinkage and contraction are governed to some extent by casting design and the gating and running conditions peculiar to individual foundries, as well as by pouring temperature, section and composition. Furthermore, the shrinkage is also materially affected by the presence of gases in the metal. During the year the Research Committee decided to extend the programme by dealing with this question and a special investigator has been appointed. So far a number of exploratory tests have been made in order to work out a suitable programme, visits are being and have been paid to the foundries of a number of members where this problem is met with. The history of previous work on the subject in various countries has been carefully studied and definitions of the terms employed have been proposed.

A limited amount of further work has been done on enamelled cast iron, on which a report has been prepared, and an examination of cast-iron pipes has been completed for the British Ironfounders' Association.

Progress on the method of graphite refinement referred to in the last report has been slow but definite. The process evolved, which in the interests of members has been covered by British Patent No. 425,227, is as follows:—Irons of coarse and open structure containing ordinary total carbon contents are treated to yield graphite in the finest possible form by including in the charge a small amount of titanium of the order of 0.2 per cent. This element can either be incorporated in the pig-irons or can be added to the ladle of molten metal from the cupola or other furnace. The molten metal is then treated with an oxidising gas, preferably carbon dioxide. The work of the year has shown the importance of two points: where the addition of titanium is made at the cupola spout, the ferro-alloy addition employed must have a melting point sufficiently low to permit rapid assimilation into the molten metal. During the year special alloys have been evolved melting at or about 1,000 deg. C., and these are particularly useful where melting temperatures are low. Secondly, titanium oxidises with such ease that precautions have to be taken to ensure that the

ferro-alloy be prevented from oxidising. Following the laboratory experiments on crucible-melted material, a number of cupola trials have been made. The experience gained in both crucible and cupola melts has suggested that the graphite structure of cast iron is governed by the nature and distribution of the slag in the metal and arrangements are contemplated for a more complete examination and analysis of these slags than has hitherto been possible.

Indications are not wanting that in the near future national specifications will be required for high-quality irons of tensile strengths up to 22 tons per sq. in., and while foundries will probably be left to decide what processes shall be employed and what composition shall be adopted for irons of this quality, it is highly probable that alloy irons will be used. It is desirable that, before these specifications are completed, the basis of testing embodied in B.S.I. Specification 321 should be revised in order to be applicable to the higher-quality material. This first national specification for cast iron was issued in 1928, and covered irons of low and medium quality of about 9 and 11 tons per sq. in. tensile strength respectively. An entirely new basis of testing was put forward in that specification, and while experience has justified the basis adopted, it is clear that in some particulars revision is needed, and it is partly with this object that an investigation has been undertaken during the year in conjunction with Vickers-Armstrongs, Limited, Barrow-in-Furness. The object of the investigation is to compare the mechanical properties of a series of test-bars of varying sizes with bars of similar sizes actually cut from a casting. A suitable casting was designed and made in two types of iron and in three types of mould. The large amount of testing involved is now in progress.

Nickel and Alloy Cast Iron Sub-Committee

The importance of alloy additions to cast iron has justified a further extension of the research programme in this respect, and an additional investigator has been appointed to concentrate on this branch alone. Work done has been in two directions, on the influence of copper and on the influence of molybdenum. The work of earlier investigators on copper has yielded such contradictory results that some systematic work was necessary, as copper is already an addition of considerable commercial importance. It is already clear that the influence it exerts depends materially upon the base composition to which the addition is made and the most appropriate addition will be governed by the initial composition. Molybdenum is another addition which has assumed commercial importance and one which produces a marked effect for the quantity added. The work done on the influence of nickel has now enabled the effect of this addition to be well understood and predictable, and its use is steadily extending. The Association's heat-resisting irons, Silal, the ferritic iron high in silicon, and Nicrosilal, the austenitic iron high in silicon and containing nickel and chromium, have made a definite place for themselves for special applications where resistance to heat and resistance to corrosion are important, and the austenitic iron Ni-resist is becoming widely used. The attention previously given to modern high-strength cast irons of the type referred to in previous reports as "inoculated" irons has during the year been mainly devoted to graphite refinement, but in the industry there has been a considerable growth of interest in inoculated irons, and for special applications and castings of suitable size and shape, irons approaching a tensile strength of 30 tons per sq. in. are available.

Tests and Specifications Sub-Committee

During the year investigations have been carried out for the Sub-Committee on the Association's standard method for the determination of sulphur, described in Research Report 105, and on the alpha-benzoin-monoxime method for the estimation of molybdenum. The sub-committee also considered a request from the British Standards Institution for compositions of iron suitable for various grades of gear wheels, and as a consequence a Gear Wheel Panel of members of the Association making these products was formed and recommendations were duly made.

Pig-Iron Sub-Committee

The Pig-iron Sub-Committee has reconsidered the recommended tolerances for foundry pig-iron and foundry refined iron, and has suggested some revisions which it is hoped will in due course be used by the industry. The object of these recommendations is to determine the limits of variation allowable on the amounts of elements in pig-iron specified by users.

White and Chilled Iron Sub-Committee

The White and Chilled Iron Sub-Committee has considered, at intervals throughout the year, a number of points relating to the production of these materials with a view to evolving a programme of investigation and suitable forms of test which can be employed. Some preliminary work has been done on the influence of composition on chill and on chill test-pieces.

Malleable Cast Iron Sub-Committee

The Malleable Cast Iron Sub-Committee has considered various developments proceeding in the production of malleable iron, with particular reference to changes in composition, alloy additions, short cycle annealing, and special annealing cycles. Work has also continued on the best type of test-bar for malleable cast iron and its relationship with the casting. The Association has taken an active part in the work of the Committee of the British Standards Institution engaged in rationalising the bend test. Work on chilling, graphite size and on shrinkage also bears on malleable-iron production.

CO-OPERATIVE INVESTIGATIONS

Combined Stress

The National Physical Laboratory Engineering Department has for some time past been engaged on an investigation of combined fatigue stresses, and has evolved a special high-speed fatigue-testing machine for determining the resistance of metals under combined flexural and torsional stresses. The Association prepared patterns for, and supplied test-pieces of, three types of cast iron to be examined in this investigation, a brittle iron of the Silal type, a good-quality pearlitic engineering iron, and a ductile austenitic iron of the Nicrosilal type. Results on the first-mentioned iron and on two steels are shortly being presented to the Institution of Mechanical Engineers. It can be said that the results on the cast iron are of the highest theoretical interest.

Cast Crankshafts

The development of the cast crankshaft for automobile work suggested the desirability of crankshaft materials being examined at the N.P.L. in the same way, since the crankshaft is an outstanding illustration of engineering material subjected to combined fatigue stresses. A programme was drawn up and the Association undertook to furnish suitable material. Subsequently, in order that the work might be done with the greatest possible speed, the Association undertook to furnish limited financial assistance, as did also a group of alloy-steel manufacturers in Sheffield, and particularly the Institution of Automobile Engineers (Research and Standardisation Committee). Suitable cast steels and cast irons are now being examined on two new machines of the type mentioned above, built specially for the investigation at the N.P.L.

High Temperature Tests

As part of the work of the Committee on Behaviour of Materials at High Temperatures, growth and creep tests have also been carried out on Silal, Ni-resist, Nicrosilal, and on plain and alloyed cast irons by the N.P.L.

Iron and Steel Industrial Research Council

Proposals have been made during the year to the Joint Committee on the Heterogeneity of Steel Ingots of the Iron and Steel Industrial Research Council of the British Iron and Steel Federation, and the Iron and Steel Institute, that a grant should be made to the Association in order to study the effect of graphite refinement on the life of ingot moulds for steel ingot. The Director is a member of the Ingot Mould Sub-Committee of the Heterogeneity Committee.

FINANCE

As indicated above, the receipt of a block grant of £5,000 from H.M. Government is conditional upon the industry furnishing a total sum of £7,000. In order to achieve this last year the following members of the Association furnished in addition to their ordinary subscriptions a sum of £306, and the Association is particularly indebted to them:—

	£	s.	d.
Babcock & Wilcox, Limited	26	5	0
Brightside Foundry & Engineering Co., Ltd.	5	5	0
British Pigirons, Ltd.	21	0	0
British Thomson-Houston Co., Ltd.	10	0	0
Darby & Co.	25	0	0
Joseph Henry, Ltd.	5	5	0
Imperial Chemical Industries, Ltd.	50	0	0
Lancashire Foundry Coke Co., Ltd.	1	1	0
London Midland & Scottish Railway Co.	10	0	0
Radiation, Limited	50	0	0
S. Russell & Sons, Ltd.	10	10	0
Sheepbridge Coal & Iron Co.	10	0	0
Stanton Ironworks Co., Ltd. ...	50	0	0
Vickers-Armstrongs, Ltd., Barrow-in-Furness	26	5	0
J. Samuel White & Co., Ltd., Cowes	5	5	0

The assistance of members generally would be valued in getting new members during the current financial year, in order that the required sum shall be obtained. Furthermore, for every £250 received from industry, over and above £7,000, a further grant of £250 will be paid, up to a limit of £3,500. By taking the fullest advantage of this offer the Association can increase its total income to £20,000 per annum, comprising £10,500 from the industry and £8,500 from grant, the remaining £1,000 representing non-grant-earning income.

Gifts

In a co-operative association it is not possible to acknowledge all gifts and services rendered, but it is desired particularly to mention the presentation of pig-iron by the Barrow Hematite Steel Company, Limited, and a speedy moisture tester by Robson's Refractories, Limited.

Tube Fittings Cartel

Under the title of the International Malleable Tube Fittings Association, an international cartel has been formed at Düsseldorf by makers of malleable fittings in Great Britain, Germany, North America, Canada, Switzerland, Czecho-Slovakia, Austria, Italy and Spain. Makers in France, Poland, Hungary, Japan, Belgium and Yugo-Slavia have not yet joined, but negotiations with the two latter are proceeding favourably. Efforts to induce the Japanese to agree in regard to the Far Eastern market have failed. Selling prices have been fixed and in some cases quotas have been settled. It is hoped that by the inclusion of countries with a depreciated currency it will be possible to arrest the marked drop in the world prices for malleable cast-iron fittings.

The Foundry of the British Northrop Loom Company

VISITED BY LOCAL FOUNDRYMEN

The 1935-36 Winter Session of the Lancashire Branch of the Institute of British Foundrymen was commenced recently, when the members paid a visit to the British Northrop Loom Company, Limited, works at Daisyfield, Blackburn. About 110 members visited the works, and they were welcomed by Mr. H. Turner, manager of the British Northrop Loom Company, Limited, who, with Mr. R. H. C. Weeks, the foundry manager, and Mr. E. L. Winter, the manager of the patternshop, accompanied the visitors round the establishment. There were also present Mr. John Jackson, the Branch-President, and Mr. J. E. Cooke, the hon. secretary.

THE FOUNDRY

Heating, Lighting and Ventilation

Mr. R. H. C. Weeks, in addressing the members of the Branch, said that in the construction of the firm's new foundry, which had been in occupation for just 12 months, particular attention was paid to ventilation and the distribution of daylight. The roof could be opened in each bay, and also there was an adequate system of ventilation at the side windows. Shower baths and changing rooms had been installed for the workmen, and everything had been done to make the moulders' working day as congenial as possible under the circumstances. The highest temperature recorded during the hottest weather was 80 deg. Fah., while casting, which was some 30 deg. lower than in the former building. Arrangements had been made also to warm the building in the early hours of the winter mornings, and this had proved beneficial in many respects. The warm air was distributed at several points by means of electric fans, and the system was supplied by the Bonecourt Boiler Company (Mather & Platt unit heater). The principle of heating was that of steam circulated through radiators through which air was forced.

The lighting system for the foundry was supplied by "Osira" mercury vapour lamps. The actual source of light was a luminous cord of gases, including mercury vapour, about $\frac{1}{4}$-in. dia. and 6 in. long. The consumption of each lamp was 420 watts, while the output of light was approximately $2\frac{1}{2}$ times that of the gas-filled tungsten lamp of equal wattage.

The rays of the mercury vapour lamp have greater penetrating powers than any other lamp, although the effect on the appearance of the human face and hands was somewhat startling. There was no doubt that the light was advantageous in the examination of a mould.

The Equipment

Speaking with reference to foundry equipment, Mr. Weeks stated that the latest possible machines had been installed to facilitate quick and cheap production. It had not been considered advisable to mechanise the plant to such an extent as to include hopper feed and automatic sand preparation.

The heaviest casting dealt with in the foundry was approximately 3 cwts., and the lightest castings only weighed ounces. Seventy tons of castings could be produced in a five-day week, involving the production of approximately 15,000 moulds, containing in all 60,000 pieces.

The main object of the company in the installation of the moulding machines had been to eliminate the very large amount of floor moulding which was so evident in the old shop, due to the entire lack of space for any expansion. Loose patterns were also being transferred to plate wherever the number off rendered it justifiable.

The largest and heaviest castings were the loom sides, which were now made by the Beardsley-Piper sandslinger. This machine travelled the length of its track each day, leaving its moulds behind it. It had been found that, in addition to the increased production, the castings were more uniform due to the even ram. Facing sand was sieved on to the pattern, and the half-box containing the loom side mould was actually rammed up in 3 min. without any springs in bolt holes. The machine was turned round each day on a centre pivot, let down on to the ground, and the balance was such that, with the help of some long poles to act as handles, the operation was a matter of minutes only.

The actual increased production of loom sides was 24 sides against ten, thus effecting a very considerable saving in the cost of production. Two overhead rails, on each of which was fitted a "Demag" hoist, were installed to facilitate the handling of the moulding boxes and pattern plates. At one side of the slinger there were three tracks of what were termed "permanent bottoms." These were adapted for anything which could be made with a flat-bottom half-mould, the top parts being rammed up on the slinger.

The lengths of sand were rolled out each day definitely level with the tops of the two rails which formed the "ends" of the box part, and the pins were so fitted that the tops could be placed in position at equally-spaced distances. This eliminated the stocking of a number of bottom parts, and showed a saving in the cost of production. Orders not justifying special moulding boxes were dealt with in a sand-pit area which was mostly used for one-off jobs in the ground.

Dealing with the Osborn roll-over jar machine (No. 403) taking patterns up to 16 in. draw, Mr. Weeks said that as in the case of the sand-slinger a small travelling crane had been fitted for the handling of equipment which, in some cases, was too heavy for the man and boy employed. The sand-preparing machines were of the latest type, and a new mill had been found very efficient both as a mill and as a time saver. The machine was self-emptying and a satisfactory bond of facing sand was secured in 4 min. The "Rotoil" machine was used exclusively for core sand.

The firm had recently changed their red sand to Weaste, which had been found to be more suitable for the up-draw machines. A 5-ton overhead crane, fitted with ball bearings, had been installed for the transportation of metal, the lifting of patterns, etc. The foundry equipment further included eleven Osborn squeeze-jolt machines and three Osborn roll-overs (No. 401). These were engaged solely on large repeat orders, the former being very suitable for flask work in large quantities. Pneumatic hammers were used for certain small loose-pattern work, but every effort was being made to eliminate this process which was obviously very costly.

The difficulty in deciding what was standard in the textile trade was one of the firm's chief causes of anxiety. Although they were "plating" all they could, the drawing office usually neutralised matters by bringing along drawings for more loose-pattern work.

Magnetic-Moulding Machines

The three magnetic-press machines would probably excite more interest than any other in the new lay-out. For regularity of squeeze, simplicity in operation, and for economy in maintenance these machines were believed to be unsurpassed. The whole unit was very compact and enclosed, and some of the reductions in price due to the new method showed a saving of 2d. or 3d. a box, and in one case of 4d. The principle of this machine depended upon the movement of the core of an electro-solenoid. During the box-filling stage the core was at its lowest position. As the current was sent through the core windings, the tendency was for the core to be drawn upwards, absorbing the magnetic flux throughout its total length. The current rush provided an instantaneous pull, and this was checked by means of oil worked on the dash-pot principle. The current being interrupted, the core rested on the oil until the operator opened a valve which allowed the oil to escape, thereby lowering the frame holding the pattern plate with a gentle downward movement. The uniformity of squeeze was due to the electric power being constant and the elimination of any pipe lines. The current used was direct, and was obtained by converting from 3-phase alternating current by means of a mercury-arc rectifier. This type of rectifier had many advantages, being cheap to run, the no-load losses being negligible. Maintenance was at a minimum; there were no brushes or moving parts and the whole was static.

The core blower was of the Coleman "Albertus" type. The main principle was the forcing by 80

Fig. 1.—The British Northrop Loom Company's Foundry by Night.

lbs. air pressure of a sufficient supply of sand to fill a box from an automatically-filled cartridge through a ½-in. or ⅝-in. nozzle. The action was virtually instantaneous on the opening of the valve by the operator, and the actual filling of the box was immediate. End- and top-pressure clamps held the box tightly in position, and it was necessary for the box joints to be in good condition or else the sand would be forced all over the surrounding area. The barrel inside the sand hopper turned automatically on the return stroke of the cartridge, and the sand pile was always kept conveniently placed to allow the cartridge moving forward to charge itself fully. The usual core binders on the market gave too "sticky" a sand to blow successfully, and it was necessary to strike a medium between a sand not too strong and yet one which would, if possible, have a good green bond. In some cases, where the corebox had several "corners," it was necessary to blow at two different positions. If this was not done, the core would have several soft places and would be useless.

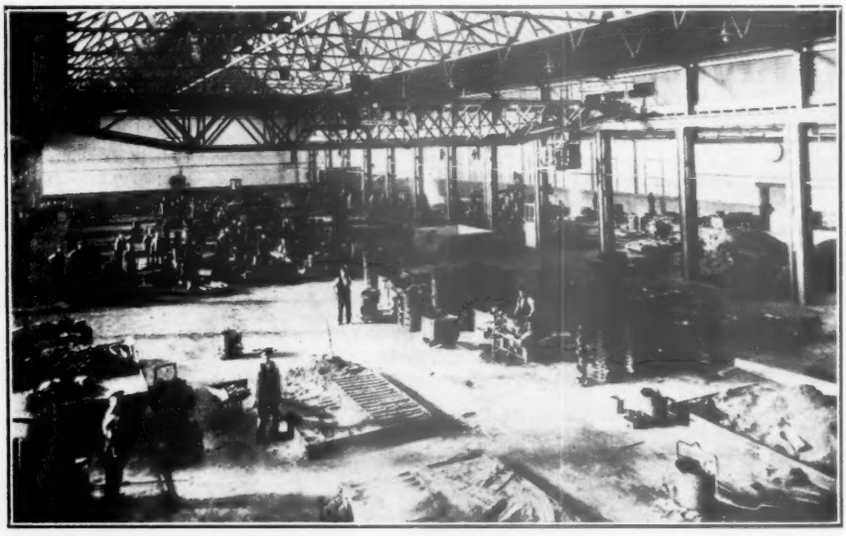

Fig. 2.—General View of the Foundry showing the New Melting Unit at the left.

Oil-Fired Melting Unit

An oil-fired rotary furnace had been installed for the use of special irons, the mixing of which in the cupola with the ordinary grey irons was not convenient or satisfactory. The fuel oil consumed was the commercial crude petroleum with a specific gravity of approximately 0.90. This was pumped automatically from a main storage tank into a feed tank, where it was warmed by means of an electric heater to ensure its flow through the pipes to the burner zone. The burner itself consisted of four small jets, which revolved at a high speed, and the oil spray was disintegrated by a small propeller spinning round on the same axis.

The air used for the burning of the fuel was supplied by an electric fan, and in order to assist in complete combustion, the air was heated in a recuperator through which the exhaust gases had passed. A pyrometer reading gave the temperature of the ingoing air and also the exhaust gases. When the latter showed approximately 900 deg. C., the recuperator damper was closed, and the exhaust travelled up the chimney stack. The metal charges, consisting of pig-iron, iron scrap, steel scrap, limestone, and coke dust, were charged in at the opposite end from the burner, and when the furnace was full the charge platform was rolled away, and the exhaust elbow moved into position. This elbow connected the furnace with the main flue. The small gap left between the two allowed the operator to see the condition of his flame, and so to decide whether the oil supply was burning correctly.

The addition of coke dust to the charge was necessary to return some of the carbon to the iron which had disappeared as carbon-monoxide in the melting operation. The quantity to be added had to be decided by data derived from experiment.

When the furnace was fully charged, the burner was lighted up with some paraffin waste, and a correct start was only made when the exhaust gases lighted at the other end. The furnace was rotated at short intervals so that the whole of the lining was evenly heated. After about an hour it was kept rotating, constantly, until it was time to tap. The tap hole was made up in the usual way, but when tapping it was not necessary to bott up when the ladle was full; the furnace was gently rotated backwards. Two slag holes were inserted, and one or both of them were opened when all the metal had been emptied out.

The average length of time for the first heat of the day was 1 hr. 50 min., the second 1 hr. 40 min., and the third 1½ hrs. The oil consumption was approximately 40 galls. per ton of metal melted. The temperature was 1,500 to 1,600 deg. C., and the oil was very uniform and very free from impurity. Care had to be taken not to prolong the length of blow, or else the silicon losses would seriously affect the composition of the iron, and urgent messages from the machine shop would follow.

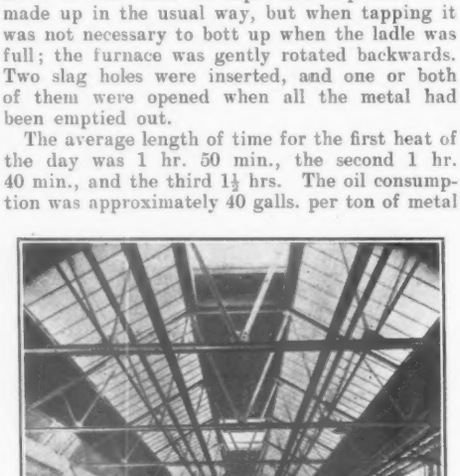

Fig. 3.—Showing the Effect of Efficient Day-Time Lighting.

The main iron mixtures for the Northrop loom were carefully weighed, and a strict check was kept on all the pig-iron analyses. Brittleness, which occurred owing to the excessive use of phosphorus, was, of course, fatal, and for that reason the West Coast hematite irons were largely utilised.

The transport of the metal by the overhead crane enabled each moulder to collect the quantity he required on site, and apart from a few men who worked in the immediate vicinity of the cupola, the supply of iron was delivered by this means.

In addition to the main foundry, there was a brass shop where all the brass, phosphor-bronze and aluminium work for the loom was done. Four coke-fired furnaces were used, experiment having proved that this method was as satisfactory as any.

The company specialised exclusively in the manufacture of automatic looms. On this account the weaving machinery called for great precision and accuracy in its construction. They had therefore developed what they believed to be a high standard of production, not only in the foundry but throughout the machine shops and fitting shops as well.

Vote of Thanks

Mr. John Jackson proposed, and Mr. J. Hogg seconded, that a very hearty vote of thanks be accorded to Mr. Weeks for his extremely interesting and informative address, and also to the directors of the British Northrop Loom Company, Limited, for their kindness in inviting the Branch to visit their establishment.

The vote of thanks was carried unanimously by acclamation and suitably responded to by Mr. H. Turner and Mr. R. H. C. Weeks.

Action of Alkalies on Refractory Materials

Mr. F. H. Clews, Mr. A. Green and Mr. A. T. Green have published in Bulletin No. 32 of the British Refractory Research Association a Report on the above subject of which the following is a summary.

(1) Test-pieces of four types of refractory material—an aluminous fireclay, a normal fireclay, a siliceous fireclay, and a silica—have been exposed to the action of potash vapour at 900 deg. and 1,000 deg. C. The aluminous material at 900 deg. C. absorbed potash the most readily, becoming at the same time mechanically disintegrated. An external viscous silicate which formed on the other fireclay materials appeared to act protectively. With the silica brick material, a fluid silicate was formed on the exterior which conferred no protection, since it dripped off in the molten state at an early stage from the test-piece.

(2) The extent to which chemical decomposition of the brick material had occurred was measured by treatment of the specimens with dilute hydrochloric acid, and weighing the undecomposed residue. With up to 55 hours' exposure, the aluminous material was affected the most, although the fireclay material at 1,000 deg. C. which had absorbed 38.5 per cent. K_2O after 95 hours, and was apparently only superficially altered, left a residue of only 37.5 per cent.

(3) The rate of volatilisation of potash from potash impregnated refractory materials at 1,000 deg. C. has been examined for contents varying up to 4 per cent. K_2O. The loss of potash from silica materials is many times more rapid than from products containing clay. A preliminary heating for 5 hours at 1,200 deg. C. results in the loss of potash from fireclay materials at 1,000 deg. C., becoming almost negligible. Silica brick material treated in the same way still loses potash much more readily than impregnated fireclay material which has not been heated above 1,000 deg. C.

Institute Elects New Members

At the Council meeting of the Institute of British Foundrymen, held at the Royal Station Hotel, Newcastle-upon-Tyne, on Saturday, October 19, the following were elected to the various grades of membership.

As Subscribing Firm.

Vickers-Armstrongs, Limited, Elswick Works, Newcastle-upon-Tyne (Representative, Mr. S. G. Homfray).

As Members.

G. A. D. Lomas, manager, foundry section, R. & J. Smith Bros., Sheffield; H. A. Fox, foundry engineer, Ford Motor Company, Limited, Dagenham; C. B. Hallam, foreman patternmaker, Beeston Boiler Company, Limited, Beeston; W. E. Hancock, instructor, Paddington Technical Institute, London, W.9; D. M. S. Parker, editor, "British Steelmaker," Russell House, London, W.C.2; S. J. Smith, managing director, Croydon Foundry, Limited, Croydon; B. A. Webb, works manager, Goubro & Scrutton, Limited, Tilbury; F. T. Bagnall, electrical steel manager, S. Fox & Company, Limited, Stocksbridge; S. G. Carey, works manager, W. J. Harris & Company, Limited, Peckham, London, S.E.; E. J. Crawley, technical manager, General Refractories, Limited, Sheffield; J. Evans, foundry proprietor, Morriston, Glam; J. C. Howard, B.Met., metallurgist, Electric Furnace Company, Limited, 17, Victoria Street, London, S.W.1; J. Lockhart, pig-iron representative, Bradley & Foster, Limited, Darlaston, Staffs; M. C. Oldham, chief chemist and metallurgist, Vickers-Armstrongs, Limited, Barrow-in-Furness; W. E. H. Oliver, coke salesman, Priestman Collieries, Limited, Newcastle-upon-Tyne; H. Marsden, works manager, Hutchinson, Hollingworth & Company, Limited, Dobcross; A. W. Foerster, mechanical engineer, Cincinnati Milling Machines, Limited, Tyburn, Birmingham; C. H. Hadley, foundry manager, Yale & Towne Manufacturing Company, Willenhall, Staffs; W. J. W. Proctor, core shop superintendent, Austin Motor Company, Limited, Birmingham; J. A. Tagg, pig-iron salesman, Darby & Company, Guildhall Buildings, Birmingham, 2; E. N. F. Tatlow, foundry manager, T. H. Mold & Son, Birchill Street, Walsall; J. F. Buchanan, works manager, Hammond Lane Foundry Company, Limited, Dublin; G. G. Mennell, foundry coke salesman, Wm. Pepper & Company, Limited, Leeds, 1; P. Tweedale, foundry requisite salesman, Grove Works, Harris Street, Rochdale

As Associate Members.

R. Dewar, patternmaker, Leyland Motors, Limited, Kingston, Surrey; W. Thomas, A.I.C., chemist, Metters, Limited, Atlantic House, Holborn Viaduct, London, E.C.1; H. Elliss, B.Met., metallurgist, B.C.I.R.A., 21, St. Paul's Square, Birmingham; D. F. Hope, assistant foundry manager, Audley Engineering Company, Limited, Newport, Shropshire; D. C. Howells, metallurgist, B.C.I.R.A., 21, St. Paul's Square, Birmingham; Piper, G. H., research chemist, B.C.I.R.A., 21, St. Paul's Square, Birmingham, 3; A. M. Tennant, metallurgist (disengaged); J. H. Barrett, assistant works manager, Sir W. G. Armstrong, Whitworth & Company (Iron-founders), Limited, Gateshead; L. Boyle, metallurgical chemist, N.E. Marine Engineering Company, Limited, Wallsend-on-Tyne; J. Dewhurst, moulder, Butterworth & Dickenson, Burnley; J. V. Elliot, foreman moulder, Hardie & Gordon, Levenbank foundry, Dumbarton; C. Gibson, foundry foreman, Ford Motor Company, Limited, Dagenham; R. Hogg, moulder, T. Ashworth & Company, Limited, Burnley; T. McIntyre, patternmaker, L.M.S. Railway Company, St. Rollox Works, Glasgow; D. V. Paranjpe, B.Sc., B.Met., foundry student, Craven Bros., Limited, Reddish; R. Pollard, moulder, Whittaker Bros., Accrington; W. Senior, foreman moulder, Geo. Keighley, Limited, Burnley; H. W. Carter, instructor, Northampton Polytechnic, London, E.C.1; H. G. C. King, patternmaker, L.M.S. Railway Company, C.M.E. Dept., Derby; H. Massey, foreman moulder, Woodhouse & Mitchell, Limited, Brighouse; T. Miller, core shop foreman, Glenfield & Kennedy, Limited, Kilmarnock; F. D. Orr, dressing shop foreman, Glenfield & Kennedy, Limited, Kilmarnock; H. T. Langley, steel foundry foreman, Austin Motor Company, Limited, Birmingham.

As Associates.

S. P. Russell, foundry apprentice, S. Russell & Sons, Limited, Bath Lane, Leicester; J. L. Green, apprentice metallurgical analyst, 6, Neal Street, Little Horton Lane, Bradford; T. Ashcroft, moulder; H. T. Bone, assistant in metallurgical laboratory, N.E. Marine Engineering Company, Limited, Wallsend-on-Tyne; F. Littlewood, apprentice metallurgical chemist, Sir W. G. Armstrong, Whitworth & Company (Iron-founders), Limited, Gateshead-on-Tyne; H. Rolls, moulder, Oxford & Cowley Ironworks, Limited, Cowley, Oxford; A. Snelson, chargehand moulder, British Insulated Cables, Limited, Prescot, Lancs.

As Students.

N. L. Corbishley; J. V. Shearer.

A New Sand Conditioning Plant

The accompanying illustrations, sent to us by Foundry Engineers, Limited, Halifax, represent a quite modern example of a complete sand-preparing plant for a foundry requiring from 10 to 30 cwts. of sand per hr. Returned sand from the mould knock-out is delivered into the hopper of the screening unit, which is the apparatus on the extreme left-hand side of Fig. 1. The sand enters the rotating barrel of the screen and, after bits of scrap, gaggers and other foreign matter have been separated out of it by the screen, it passes into a bucket at the foot of the elevator to the right of the screening unit. When the bucket is full, it rises to the top of the elevator and automatically discharges the sand into the circular mill at the top right of the elevator. One motor suffices to drive the elevator and the screen.

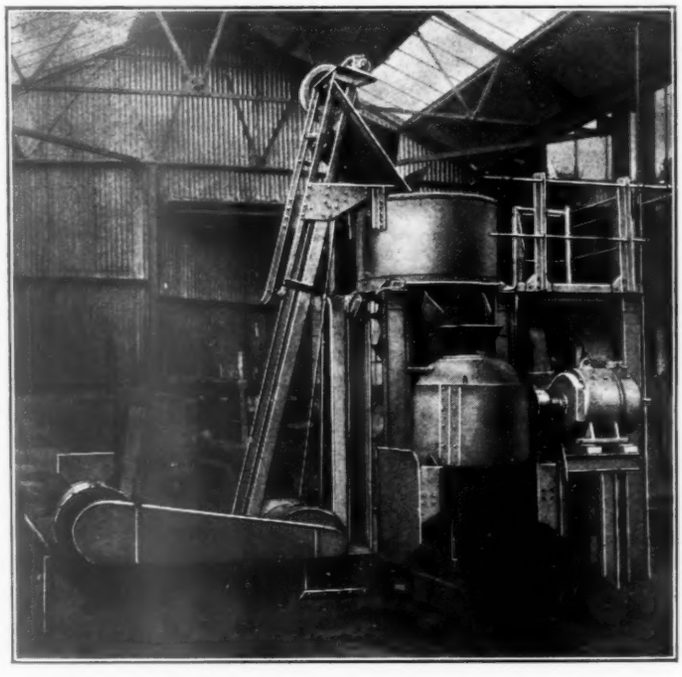

Fig. 1.—A New Sand-Conditioning Plant designed by Foundry Engineers, Limited.

Fig. 2.—Side View of the Plant showing its Adaptation for Core Sand Preparation.

When the sand is sufficiently milled, it is discharged into the aerating disintegrator seen below the mill, and is then ready for distribution to the moulders.

The equipment has a dual purpose, as it is in alternate use for preparing core sand. Core sand is not required to pass through the disintegrator, so there is a second discharging point from the mill, and the treated core sand passes out on the opposite side of the plant, down the long shute shown in Fig. 2.

This Week's News in Brief

Trade Talk

A WINDING-UP ORDER in the case of the Gateshead Foundry, Limited, Pipewellgate, Gateshead, on October 16.

MESSRS. DARWINS, LIMITED, Sheffield, have opened a branch office and warehouse in Birmingham at 49-51 Cornwall Street.

THOMAS W. WARD, LIMITED, of Jarrow-on-Tyne, who are to break up the "Olympic," have catalogued 4,456 lots for the sale by auction by Messrs. Knight, Frank & Rutley, commencing on November 5.

A CONTRACT HAS BEEN SIGNED between Messrs. Yarrow & Company, Limited, Scotstoun, and the Jugo-Slav Government for boilers and machinery for three destroyers. The value of the contract is over £500,000.

ORDERS FOR £10,000 worth of steelwork for bridges have been placed on the North-East Coast and in South Wales by the New Zealand Railways. The material is to be shipped within a month from Newport and Middlesbrough.

A LONDON COMPANY is negotiating for the purchase of the Arrol-Johnstone Motor Works at Dumfries, and has obtained an option on the buildings. During the war the works were used for the manufacture of aeroplane engines, and at one time 2,000 men were employed.

THE L.M.S. RAILWAY COMPANY, LIMITED, announce that they have placed orders with British manufacturers for nearly 900 new road vehicles. These orders, which comprise the L.M.S. programme for the present year, have been made with the twofold object of improving the company's existing fleet of road vehicles and making provision for increasing traffic requirements. Among the various types of vehicles ordered are works trucks, parcels vans, tipping lorries, mechanical horse tractors and trailers, and light and heavy goods lorries.

AT THE RECENT Council meeting of The Institute of Vitreous Enamellers, the following were elected to different grades of membership:—As *Subscribing Firms*, Welwyn Enamelling Company, Limited, 19, Broadwater Road, Welwyn Garden City; Mitchell, Russell & Company, Limited, Chattan Foundry, Bonnybridge, Scotland. As *Members*, Mr. Henry Ellard, Broad Lane, Wednesfield, Staffs; Mr. George M. Logan, Saunders & Conner (Barrhead), Limited, Sanitas and Darnley Works, Barrhead, Renfrewshire; Mr. Francis Percy Taylor, Saunders & Conner (Barrhead), Limited, Sanitas and Darnley Works, Barrhead, Renfrewshire. As *Associates*, Mr. Eric Williams, Sterling Manufacturing Company, Davis Street, Cubitt Town, London, E.14; Mr. Paul Jurgensmeyers, Sterling Manufacturing Company, Davis Street, Cubitt Town, London, E.14; Mr. William Akers, Sterling Manufacturing Company, Davis Street, Cubitt Town, London, E.14.

Company Reports

Tweedales & Smalley (1920), Limited.—Interim dividend of 4 per cent.

Broken Hill Proprietary Company, Limited.—Half-yearly dividend of 1s. 3d. a share (Australian currency), equal to 6¼ per cent.

Lancashire Steel Corporation, Limited.—The directors announce that the dividend on the 1,400,000 £1 5 per cent. cumulative redeemable first preference shares for the period from the date of allotment to October 31 is payable on November 1.

Contracts Open

Cam, November 6.—1,700 yds. of 3-in. spun cast-iron mains, for the Dursley Rural District Council. Mr. R. C. Workman, waterworks inspector, 95, Highfields, Dursley. (Fee £1 1s., returnable.)

Biddulph, November 5.—160 yds. 9-in. cast-iron water main, 800 yds. 6-in. and 2,000 yds. 4-in. ditto, for the Urban District Council. The Water Engineer, Public Hall, Biddulph. (Fee £2, returnable.)

Personal

MR. DAVID MCGUFFIE has been appointed manager of the foundries of Joseph Cook, Sons & Company (1930) Limited, Washington, Co. Durham.

MR. JOHN GEMMELL, SEN., who has been for many years foreman in the foundry of Bo'ness Iron Company, Limited, has been presented with a wireless set by the officials and employees of the firm on the occasion of his retirement.

ALDERMAN W. H. SHAW, J.P., chairman of directors of Messrs. James Austin & Sons (Dewsbury), Limited, Thornhill Iron & Steel Works, is to receive the Freedom of the Borough of Dewsbury. Alderman Shaw entered Dewsbury Town Council in 1918, and has twice been Mayor. He gave many years as chairman of the Finance and Parliamentary Committee, and also as chairman of the Education Committee. He has been an alderman since 1924.

MR. JAMES L. WICK, JUN., President and general manager of the Falcon Bronze Company, Youngstown, O., U.S.A., and a director of the American Foundrymen's Association, has been elected Vice-President of the association, to fill the vacancy occasioned by the death of Mr. B. H. Johnson. Mr. Wick has been active in the association for many years, serving on committees and as a director. Mr. E. H. Ballard, General Electric Company, West Lynn, Mass., has been elected to the board of directors of the association, to fill the unexpired term of Mr. Wick. The following members of the board were elected members of the executive committee to serve with the President, Vice-President and executive secretary:—Mr. Frank J. Lanahan, Fort Pitt Malleable Iron Company, Pittsburgh; Mr. R. J. Teetor, Cadillac Malleable Iron Company, Cadillac, Mich.; Mr. E. O. Beardsley, Beardsley & Piper Company, Chicago; and Mr. W. L. Seelbach, Forest City Foundries Company, Cleveland.

Company Meeting

The annual meeting of Murex, Limited, was held in London recently. MR. GEO. P. JOSEPH (chairman) gave details of the new developments in connection with their process for the production of magnesium and its alloys, which, he said, was of increasing importance in the manufacture of aircraft and light castings generally. The negotiations in relation to this business commenced in 1933 and were brought to a successful conclusion, with the result that, in conjunction with Messrs. Johnson Matthey & Company, the firm who controlled certain fabricating patents, two companies were formed, the first of which was Magnesium Metal & Alloys, Limited. This company was to confine its activities to the production of magnesium and magnesium alloys. The second company was named Magnesium Castings & Products, Limited, and was to concern itself with the fabrication of the magnesium. This company owned the patents acquired on the original formation. In both these companies Murex, Limited, held a substantial interest. They leased to Magnesium Metal & Alloys, Limited, a portion of the land acquired in 1933, on which was erected the necessary plant and machinery, and production of magnesium commenced about April of this year. Before the company was actually in production the opportunity occurred of effecting a merger of the principal firms interested in the future of magnesium in this country. Negotiations had now resulted in the formation of a company known as Imperial Magnesium Corporation, Limited, in which the participants were Magnesium Metal & Alloys, Limited, the British Aluminium Company, Limited, the Imperial Smelting Corporation, Limited, and Imperial Chemical Industries, Limited. Imperial Magnesium Corporation, Limited, had agreed to take over the plant and buildings of Magnesium Metal & Alloys, Limited, which was operating the Murex process for the production of magnesium at Rainham. Their subsidiary, Murex Welding Processes, Limited, in which they held all the capital, had again shown considerable expansion. Their enlarged works had been fully occupied and they might have to move to larger premises to make room for further extensions.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

434,965. ROYEN, H. J. VAN. Manufacture of rails and the like.

435,000. VEREINIGTE STAHLWERKE AKT.-GES. Apparatus for lining the interior walls of hollow bodies, such as tubes or the like.

435,003. CHEMISCHE FABRIK R. BAUMHEIER AKT.-GES. Anti-corrosion coating compositions.

435,093. ISABELLEN-HUTTE GES., and HEUSLER, DR. F. Production of acid-resistant silicon-iron casting.

435,165. BOSCH AKT.-GES., R. Power-operated hand-shears for cutting sheet metal.

435,193. BRITISH THOMSON-HOUSTON COMPANY, LIMITED, and WHITELEY, A. L. Electric welding apparatus.

435,223. MATSUNAWA, S., NOZAWA, F., and SUZUKI, M. Heat-treatment of steels and iron alloys.

435,247. RÜPING, M. Rail joints for railway rails.

435,271. GURNEY, N. R. D., and ASSOCIATED ELECTRICAL INDUSTRIES, LIMITED. Controlling-arrangements for rolling mills.

435,292. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Closure devices for furnace observation openings.

435,307. JACKSON, L. MELLERSH- (Krupp Grusonwerk Akt.-Ges., F.). Lift-over device for rolling mills.

435,316. HURST, J. E., and BRADLEY & FOSTER, LIMITED. Production of cast-iron castings surface-hardened or hardenable by the nitrogen-hardening process.

435,420. GRAHAM, J. Process for preventing corrosion on metals.

435,438. BRITISH THOMSON-HOUSTON COMPANY, LIMITED. Methods of testing ferromagnetic substances.

435,448. OESTERREICHISCH AMERIKANISCHE MAGNESIT AKT.-GES. Production of non-spalling highly-refractory chromite bricks.

Obituary

MR. JOHN HESLEDEN, head of the firm of Struger & Company, pulley and chain manufacturers, of Old Hill, died on Saturday. He was 58 years of age.

Forthcoming Events

NOVEMBER 4.

Sheffield Society of Engineers and Metallurgists:—Joint meeting with the Iron and Steel Institute and the Sheffield Metallurgical Association to discuss the Sixth Report of the Heterogeneity Committee of the Iron and Steel Institute. There will be two sessions at the Mappin Hall, St. George's Square, Sheffield, starting at 3 p.m. and 7.30 p.m. respectively, with an interval for tea.

Institute of British Foundrymen

NOVEMBER 1.

Birmingham, Coventry and West Midlands Branch:—"Refractories for Foundry Use," Paper by W. J. Rees, M.Sc., at the James Watt Memorial Institute, York House, Great Charles Street, Birmingham, at 7.30 p.m.

Lincolnshire Section:—"Some Details of Modern Foundry Control," Paper by G. W. Brown, M.I.Mech.E., at the Technical College, Monks Road, Lincoln, at 7 p.m.

NOVEMBER 2.

Lancashire Branch:—"Die Castings," Paper by A. H. Mundey, at the Engineers' Club, Albert Square, Manchester, at 4 p.m.

NOVEMBER 9.

Scottish Branch:—"The Balanced-Blast Cupola." Paper by W. Y. Buchanan, at the Royal Technical College, George Street, Glasgow, at 4 p.m.

NOVEMBER 12.

Burnley Section:—"Castings Viewed from the Machine Shop re Machinability," Paper by J. Jackson, at the Municipal College, Ormerod Road, Burnley, at 7.15 p.m.

The Institute of Vitreous Enamellers

NOVEMBER 7.

Manchester:—"Notes on Furnaces for the Vitreous Enamelling Industry," Paper by Th. Teisen, C.E., at Y.M.C.A., Peter Street, Manchester, at 7.30 p.m.

XUM

By courtesy of the Watford Foundry Company Limited

W'BRO' RIXON'S No.3 Foundry Iron

In the foundry illustrated above, thin-walled rain-water pipes are being produced with Rixon's W'bro' Foundry Pig Iron.

FLUIDITY

The high phosphorus content of this iron ensures the fluidity necessary to secure clean, sharply-moulded light castings. The analysis is as follows:—

	Per cent
Silicon	3.29
Sulphur	0.025
Phosphorus	1.65
Manganese	0.34
Graphitic Carbon	3.52
Combined Carbon	0.12
Total Carbon	3.64

The Stanton Ironworks Company Limited, Near Nottingham

Raw Material Markets

Foundrymen, engineers and steelmakers are well employed and as a result many of the blast furnaces and steel plants are being hard pressed for deliveries. In all probability more blast furnaces will have to be put into operation in order to cope with present demands. Recent shipbuilding orders have given encouragement to the heavy trades and many consumers of structural materials are covering themselves far in advance of known requirements, as a precautionary measure against increased prices. Of these materials, joists and sections have been in very active demand.

Pig-Iron

MIDDLESBROUGH.—Buyers of Cleveland iron are continuing to take out their full quotas under current contracts and these will account for the full output over a considerable period. Shipments of pig-iron have been of rather less volume recently and the export trade shows little activity. Prices are unchanged at the fixed minimum quotations. Consumption of hematite is steady and stocks of iron show a tendency to decrease. Prices for home trade are unchanged at the fixed minimum levels, but there is no system of price control for export transactions.

LANCASHIRE.—Business in pig-iron in this area is on a large scale and many foundries are purchasing well beyond their present requirements. In some cases they have booked forward until June of 1936. The light-castings trade continues to have large requirements, while the machine-tool trade, the jobbing foundries, the heavy electrical branch, and general engineering firms are all taking up satisfactory tonnages of iron and other metals. Staffordshire, Derbyshire and Lancashire brands of No. 3 foundry iron, equal to Derbyshire, are all on offer for delivery to users in the Lancashire price zone on the basis of 74s. per ton, with Northamptonshire at 72s. 6d., and Scottish foundry at about 81s. 6d., whilst East Coast hematite for delivery equal to Manchester ranges from 80s. 6d. to 81s., and West Coast material is quoted at 81s.

MIDLANDS.—Light-castings makers are well employed and are consuming large quantities of pig-iron. Deliveries, in this district, are expected to exceed those of last month. New business is scarce, as most of the local ironfounders are well covered over several months. Quotations are unchanged and for South Staffordshire are 67s. 6d. per ton for Northants No. 3 and 71s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, which include delivery to Birmingham and Black Country stations, and are subject to a small sliding-scale rebate to large consumers. Special irons are in demand by the engineering and the jobbing foundries and prices, which vary considerably owing to quality and the tonnages concerned, are as follow:—Medium-phosphorus pig-iron, 72s. to 82s. 6d.; low-phosphorus, 85s. to 90s.; specially-refined iron, £5 7s. 6d. to £7 per ton. There is little change in the condition of the hematite market and prices are unchanged. West Coast mixed numbers delivered Midland stations are at 84s. 6d., and for East Coast No. 3, 83s. 6d. is quoted, while Welsh mixed numbers are at 83s. per ton. For delivery into consumers' works in 10-ton lots, an additional 1s. 6d. per ton is charged.

SCOTLAND.—Consumption of pig-iron in this district continues to be satisfactory and the market maintains its firm tone. Recent shipbuilding orders have given an added impetus to the market and the outlook is favourable. Prices are unchanged, No. 3 foundry being at 70s. f.o.t. furnaces, with 2s. 6d. per ton extra for No. 1. The light-castings manufacturers are taking up satisfactory tonnages. Cleveland No. 3 foundry is still at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow. Other English foundry irons are 1s. 3d. per ton less than these quotations. Local steelworks should also benefit from shipbuilding contracts and they are expected to be well employed for some considerable time. Quotations for steel-making irons are:—Mixed numbers Scottish hematite, 73s. 6d.; mixed numbers West Coast hematite, 74s.; mixed numbers East Coast hematite, 74s.; basic, British and Indian, 70s., less 5s. rebate, all delivered steelworks here.

Coke

There have been no changes in prices on the foundry-coke market, but it would not be surprising if some alterations were made. The position of the market is strong and demand is good. For delivery at Birmingham and Black Country stations best Durham coke is 36s. 6d. to 40s. per ton, while Welsh quality is on offer at from 32s. 6d. to 43s. 6d. per ton.

Steel

The busy conditions which developed in the steel market at the beginning of October are well maintained, and heavy tonnages of steel are passing into consumption, says the official report of the London Iron and Steel Exchange. Practically all branches of the industry are assured of active working conditions for several months to come, and in some departments it is difficult to place orders except for extended delivery. In the semi-finished steel section of the market some of the producing works are unable to accept orders for execution this year. Consumers for the most part have contracted well forward, but there is a considerable volume of new business offering. Active conditions rule in the finished-steel market, but some irregularity is noticeable in the rate of operations in the various departments. The home trade continues to absorb large tonnages, particularly of structural steel, while the demand for shipbuilding steel is increasing as a result of the recent orders for ships.

Scrap

It was expected in some quarters of the Cleveland market that growing stringency would compel the price of heavy melting steel scrap to be raised, but as yet no change has been made. Supplies are low and only small tonnages are being sold at the recognised market price of 52s. 6d. per ton. There is an increasing call on both ordinary foundry cast-iron scrap and machinery metal, but the prices remain at 52s. 6d. and 54s. respectively, and supplies are still on offer. The price of light metal is now 43s. 6d. per ton delivered works, and there has been an increase in the number of inquiries. In the South Wales market the demand for iron and steel scrap is well maintained, but as the quantity of material on offer is limited, the volume of business is restricted. Good, heavy steel scrap in furnace sizes is at 57s. 6d. to 60s. per ton. Heavy cast iron in furnace sizes is inactive at 53s. while light cast-iron scrap is attracting some buyers at 46s. Good, clean, cast-iron machinery scrap in foundry sizes has a small local demand at 57s. 6d. to 60s. per ton. Conditions on the Midland market are very active and the demand generally is good. Heavy machinery cast iron is at 57s. 6d., good heavy at 50s., and clean light at 47s. 6d. per ton. The Scottish market for iron and steel scrap continues firm and prices have been well maintained. Machinery cast-iron scrap has had a rather increased demand from the foundries and the ironworks have been in the market for good piling wrought iron, which is rather scarce, and as a result purchasers have been compelled to increase their offers.

Metals

Copper.—This metal has fluctuated a lot recently. Following Sir Samuel Hoare's speech last week, the market developed a more subdued tone, but Mr. Baldwin's speech which was broadcast later, and in which he spoke of rearmament, was the cause of giving the metal markets as a whole, and especially the copper market, a firmer appearance. At the moment buying is not frequent, but it is reported that many of the larger consumers are keeping a watchful eye on the situation and may commence further buying without warning. Consumption in Europe and in the United States has been well maintained. The demand for copper from Italy is not on such a large scale as it was a few weeks back.

Daily market prices:—

Cash.—Thursday, £35 5s. to £35 6s. 3d.; Friday, £35 6s. 3d. to £35 7s. 6d.; Monday, £34 16s. 3d. to £34 17s. 6d.; Tuesday, £34 13s. 9d. to £34 15s.; Wednesday, £34 16s. 3d. to £34 17s. 6d.

Three Months.—Thursday, £35 12s. 6d. to £35 13s. 9d.; Friday, £35 13s. 9d. to £35 15s.; Monday, £35 5s. to £35 6s. 3d.; Tuesday, £35 1s. 3d. to £35 2s. 6d.; Wednesday, £35 3s. 9d. to £35 5s.

Tin.—The announcement of a 10 per cent. increase in quotas from October 1 resulted in a sharp drop in prices, but there was a recovery later. It is generally expected that consumers will be rather wary in their buying. According to the statistics published by The Hague Bureau, the world apparent consumption of tin during the first eight months of this year was 90,910 tons. Should consumption be kept at the same average up to the end of the year, the total will be about 121,000 tons.

Day-to-day fluctuations:—

Cash.—Thursday, £221 to £223; Friday, £225 10s. to £226; Monday, £222 to £223; Tuesday, £220 10s. to £221; Wednesday, £217 15s. to £218.

Three Months.—Thursday, £213 17s. 6d. to £214; Friday, £215 to £215 5s.; Monday, £214 to £214 5s.; Tuesday, £212 10s. to £212 15s.; Wednesday, £211 5s. to £211 10s.

Spelter.—This is a rather colourless market, and, apart from the demand from brassmakers, who have good requirements, there is very little activity. The market continues to suffer through the very poor state of the galvanising industry. Brassmakers are consuming satisfactory quantities of high-grade zinc, and there is also an improved demand from colour makers. In the United States markets, new buying is quiet following a period of very heavy demand.

Official quotations were as follow:—

Ordinary.—Thursday, £16 7s. 6d.; Friday, £16 11s. 3d.; Monday, £16 5s.; Tuesday, £16 3s. 9d.; Wednesday, £16 5s.

Lead.—The building trade continues to be well in the market for lead, and a good demand is expected from this source for some considerable time. Monthly deliveries of pipes and sheets in this country have been between 11,000 and 13,000 tons for well over a year. The building-trade demand is further encouraged by the efforts of the Government to clear the slums and prevent overcrowding. Consumption has decreased recently, following the period of heavy buying at the beginning of the month.

Day-to-day quotations:—

Soft Foreign (Prompt).—Thursday, £18; Friday, £18; Monday, £17 15s.; Tuesday, £17 7s. 6d.; Wednesday, £17 7s. 6d.

Sale of Marshalls', Gainsborough

By order of the Court a contract has been confirmed for the sale of the whole of the assets of the world-famous firm of Marshall Sons & Company, Limited, of Gainsborough, Lincs, to the Sheffield firm of Thos. W. Ward, Limited. The well-known Britannia Works, together with the Carr House and Trent Works, represent one of the chief industries of the town of Gainsborough, and the products of the company are to be found all over the world. The business was commenced in the year 1848 by the late Mr. William Marshall and his two sons, well-known figures in the agricultural and general engineering industry. It extended until finally it was occupying magnificent works to the extent of approximately 33 acres, representing a value of considerably over £1,000,000 of paid up capital and debentures. Its difficulties began in the extraordinary post-war period. Although even before the war it was employing nearly 4,000 hands, the number was increased considerably during hostilities. At the present time some 930 workman are engaged, and the outcome of the present developments will be closely watched by the people of Gainsborough in view of its vital effect upon the town's welfare and prosperity. The whole position is being reviewed carefully by the present owners, whose first object if at all possible is to secure the continuance of the industry at Gainsborough. With re-organisation, effective management and control it is felt that there should still be an important and useful future for the whole undertaking.

RESOURCES

NAL BLACK

CK GANISTER

nd the Armitage Mines, Deepcar

acture of Ground Ganister

NOTHING BETTER FOR THE LINING OF CUPOLAS THAN A REALLY HIGH CLASS GROUND GANISTER HAS EVER YET BEEN DISCOVERED — CHEAP "PRICE CUT" RUBBISH IS DEAR AT ANY PRICE

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FINAL COST ——————————→ INFINITELY CHEAPER

With entire freedom from trouble and worry

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156, St. Vincent Street, C.2.

Telephone : Central 5250.
Telegrams : Genefax, Glasgow.

RAW MATERIALS—PRICE LIST

(Wednesday, October 30, 1935)

COPPER

	£	s.	d.
Standard cash	34	16	3
Three months	35	3	9
Electrolytic	39	5	0
Tough	37	15	0
Best selected	38	5	0
Sheets	68	0	0
India	49	10	0
Wire bars	39	15	0
Ingot bars	39	15	0
H.C. wire rods	43	5	0
Off. av. cash, Sept.	34	1	5⅝
Do., 3 mths., Sept.	34	9	5 11/16
Do., Sttlmnt., Sept.	34	1	6¼
Do., Electro, Sept.	38	4	10⅞
Do., B.S., Sept.	37	9	4½
Do., wire bars, Sept.	38	10	8¾
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			6½d.

BRASS

Solid drawn tubes	9¾d.
Brazed tubes	11½d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7⅞d.
Wire	7½d.
Rolled metal	7¾d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	217	15	0
Three months	211	5	0
English	218	0	0
Bars	218	0	0
Straits (nom.)	219	15	0
Australian (nom.)	218	5	0
Eastern	216	15	0
Banca (nom.)	219	15	0
Off. av. cash, Sept.	224	3	3⅜
Do., 3 mths., Sept.	212	12	4½
Do., Sttlmt., Sept.	224	2	7⅜

SPELTER

	£	s.	d.
Ordinary	16	5	0
Remelted	15	5	0
Hard	13	5	0
Electro 99.9	18	18	9
English	17	5	0
India	14	10	0
Zinc dust	19	0	0
Zinc ashes	4	10	0
Off. aver., Sept.	15	10	3⅛
Aver. spot, Sept.	15	8	3⅞

LEAD

	£	s.	d.
Soft foreign ppt.	17	7	6
Empire (nom.)	18	2	6
English	19	10	0
Off. average, Sept.	16	5	9⅜
Average spot, Sept.	16	5	2⅜

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	12	6
Do., V.M. ex-whse.	25	10	0
Rods	29	0	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	83	0	0 to	84	0	0
Chinese, ex-whse.				74	0	0
Crude, c.i.f.				38	15	0

QUICKSILVER

	£	s.	d.	£	s.	d.
Quicksilver	11	12	6 to	12	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£12 15 0
75%	£17 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/6 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£18 0 0 to £20 0 0
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	£33 0 0
4/6% car.	£21 15 0
6/8% car.	£21 0 0
8/10% car.	£21 0 0
Ferro-chrome—	
Max. 2% car.	£34 0 0
Max. 1% car.	£36 5 0
Max. 0.70% car.	£37 5 0
70%, carbon-free	9½d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/6 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to 11 5 0
76/80% packed	£11 15 0 to 12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	17	6 to	3	0	0
Mixed iron and steel	2	12	6 to	2	15	0
Heavy cast iron				2	13	0
Good machinery	2	17	6 to	3	0	0
Cleveland—						
Heavy steel				2	12	6
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy cast iron				2	12	6
Heavy machinery				2	14	0
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron	2	17	6 to	3	0	0
Steel turnings				1	15	6
Scotland—						
Heavy steel				2	10	0
Ordinary cast iron	2	11	6 to	2	12	6
Engineers' turnings				2	0	0
Cast-iron borings	1	17	6 to	1	18	9
Wrot-iron piling	2	17	6 to	3	0	0
Heavy machinery				2	16	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	29	0	0
Brass	19	0	0
Lead (less usual draft)	16	0	0
Tea lead	12	0	0
Zinc	9	0	0
New aluminium cuttings	72	0	0
Braziery copper	26	0	0
Gunmetal	27	0	0
Hollow pewter	155	0	0
Shaped black pewter	120	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	71/-
Hematite M/Nos.	70/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	74/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	73/6
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
W.C. hematite	86/-
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell. No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	81/6
Clyde, No. 3	81/6
Monkland, No. 3	81/6
Summerlee, No. 3	81/6
Eglinton, No. 3	81/6
Gartsherrie, No. 3	81/6
Shotts, No. 3	81/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	10	0 to	8	0	0
Hoops	10	10	0 and up.			
Marked bars (Staffs) f.o.t.			12	0	0	
Gas strip	10	10	0 and up.			
Bolts and nuts, ¾ in. × 4 in.			15	0	0 and up.	
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	9	5	0 to	9	7	6
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ⅜ in. (Untested)				8	12	0
Flats—8 in. wide and over				8	12	6
,, under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)				9	7	0
Black sheets, 24g. (4-t. lots)				11	5	0
Galv. cor. shts. (,,)				13	5	0
Galv. flat shts. (,,)				13	15	0
Galv. fencing wire, 8g. plain				14	10	0
Billets, soft	5	10	0 and up.			
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	10	0 to	5	12	6
Tin bars	5	10	0 to	5	12	6

PHOSPHOR BRONZE

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	11½d.
Tubes	14d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

Rolled—	Per lb.
Ingots for raising	7d. to 1/1
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.31
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Malleable, Valley	18.50
Grey forge, Valley	18.00
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	27.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.40
Plain wire	2.30
Barbed wire, galv.	2.80
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 20/-
Durham foundry	20/- to 21/-
,, furnace	16/6 to 17/9
Scotland, foundry	28/-
,, furnace	25/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14	per box	18/9
,,	28×20	,,	37/6
,,	20×10	,,	27/-
,,	18¾×14	,,	19/6
C.W.	20×14	,,	15/6 to 15/9
,,	28×20	,,	33/6 to 34/-
,,	20×10	,,	22/9
,,	18¾×14	,,	15/9

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£ s. d.	
Oct. 24 ..	35 5 0 inc.	12/6
„ 25 ..	35 6 3 „	1/3
„ 28 ..	34 16 3 dec.	10/–
„ 29 ..	34 13 9 „	2/6
„ 30 ..	34 16 3 inc.	2/6

Electrolytic Copper

	£ s. d.	
Oct. 24 ..	39 15 0 inc.	10/–
„ 25 ..	39 15 0 No	change
„ 28 ..	39 10 0 dec.	5/–
„ 29 ..	39 5 0 „	5/–
„ 30 ..	39 5 0 No	change

Standard Tin (cash)

	£ s. d.	
Oct. 24 ..	221 0 0 inc.	90/–
„ 25 ..	225 10 0 „	90/–
„ 28 ..	222 0 0 dec.	70/–
„ 29 ..	220 10 0 „	30/–
„ 30 ..	217 15 0 „	55/–

Tin (English ingots)

	£ s. d.	
Oct. 24 ..	222 0 0 inc.	100/–
„ 25 ..	225 10 0 „	70/–
„ 28 ..	222 10 0 dec.	60/–
„ 29 ..	221 0 0 „	30/–
„ 30 ..	218 0 0 „	60/–

Spelter (ordinary)

	£ s. d.	
Oct. 24 ..	16 7 6 inc.	5/–
„ 25 ..	16 11 3 „	3/9
„ 28 ..	16 5 0 dec.	6/3
„ 29 ..	16 3 9 „	1/3
„ 30 ..	16 5 0 inc.	1/3

Spelter (Electro, 99.9 per cent.)

	£ s. d.	
Oct. 24 ..	18 18 9 inc.	3/9
„ 25 ..	19 3 9 „	5/–
„ 28 ..	18 17 6 dec.	6/3
„ 29 ..	18 17 6 No	change
„ 30 ..	18 18 9 inc.	1/3

Zinc Sheets (English)

	£ s. d.	
Oct. 24 ..	25 0 0 No	change
„ 25 ..	25 0 0 „	„
„ 28 ..	24 15 0 dec.	5/–
„ 29 ..	24 12 6 „	2/6
„ 30 ..	24 12 6 No	change

Lead (English)

	£ s. d.	
Oct. 24 ..	20 0 0 inc.	10/–
„ 25 ..	20 0 0 No	change
„ 28 ..	19 15 0 dec.	5/–
„ 29 ..	19 10 0 „	5/–
„ 30 ..	19 10 0 No	change

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1901	8 0 0	7 10 0	7 5 0	7 0 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 15 0	6 17 11
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 7 0	6 5 0	6 9 4
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11½
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10½
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0
1909	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 2 6	5 17 6	5 19 9½
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 6	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 12 6	6 16 6	6 7 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 6 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 6 0
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 3 9½
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5½
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 0½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11½	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0	12 12 6	12 12 6	12 14 3½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 4 6	11 18 6	11 13 9	11 13 0	12 6 2½
1926	11 7 9½	11 5 0	11 5 0	11 5 0	11 3 9	11 3 9	11 5 0	12 0 0	13 0 0	*	15 7 6	12 19 0	12 0 2
1927	12 6 3	12 2 6	11 14 0	11 0 0	10 18 9	10 13 6	10 12 6	10 5 0	9 16 0	9 15 0	9 13 9	9 12 9	10 14 2
1928	9 12 6	9 11 0	9 11 0	9 10 0	9 8 4	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 3 6	9 1 3	9 7 0
1929	9 0 0	9 2 6	9 5 7½	9 9 4½	9 10 0	9 17 6	10 2 6	10 2 6	10 2 6	10 0 6	10 3 9	10 5 7	9 15 2½
1930	10 7 6	10 7 6	10 7 6	10 6 10½	10 6 3	10 5 0	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 4 7½
1931	10 2 6	10 0 0	10 0 0	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 16 10½	9 18 0½
1932	9 15 0	9 15 0	9 15 0	9 15 0	9 13 9	9 11 3	9 10 0	9 10 0	9 10 0	9 6 3	9 5 0	9 5 0	9 10 11½
1933	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0
1934	9 5 0	9 8 1½	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 11 6
1935	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	—	—	—	—

* No quotation available owing to strike.

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